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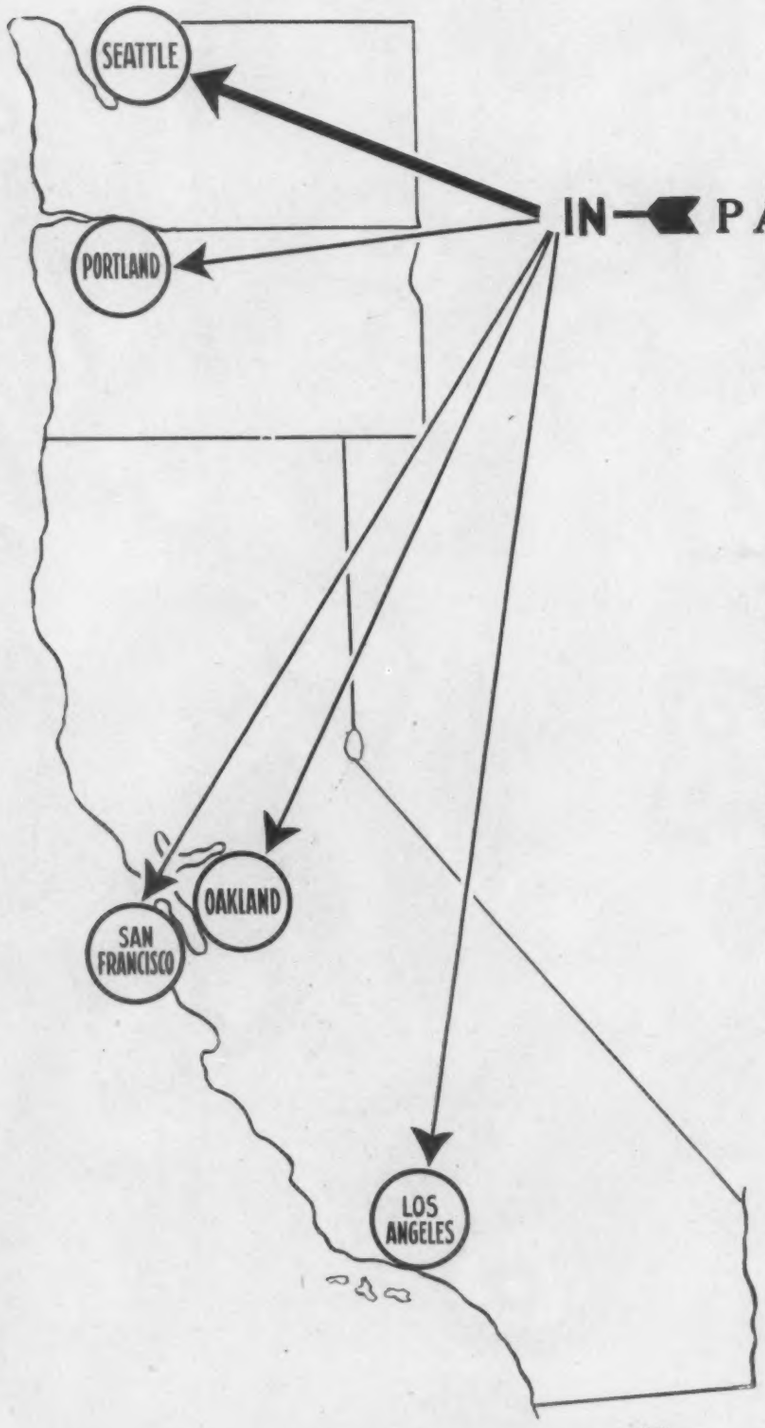

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POWER AND GAS
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VOLUME XXIX SAN FRANCISCO, NOVEMBER 9, 1912 NUMBER 19

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WOOD STAVE PIPE DISTRIBUTION

BY H. J. KENNEDY, M. E.

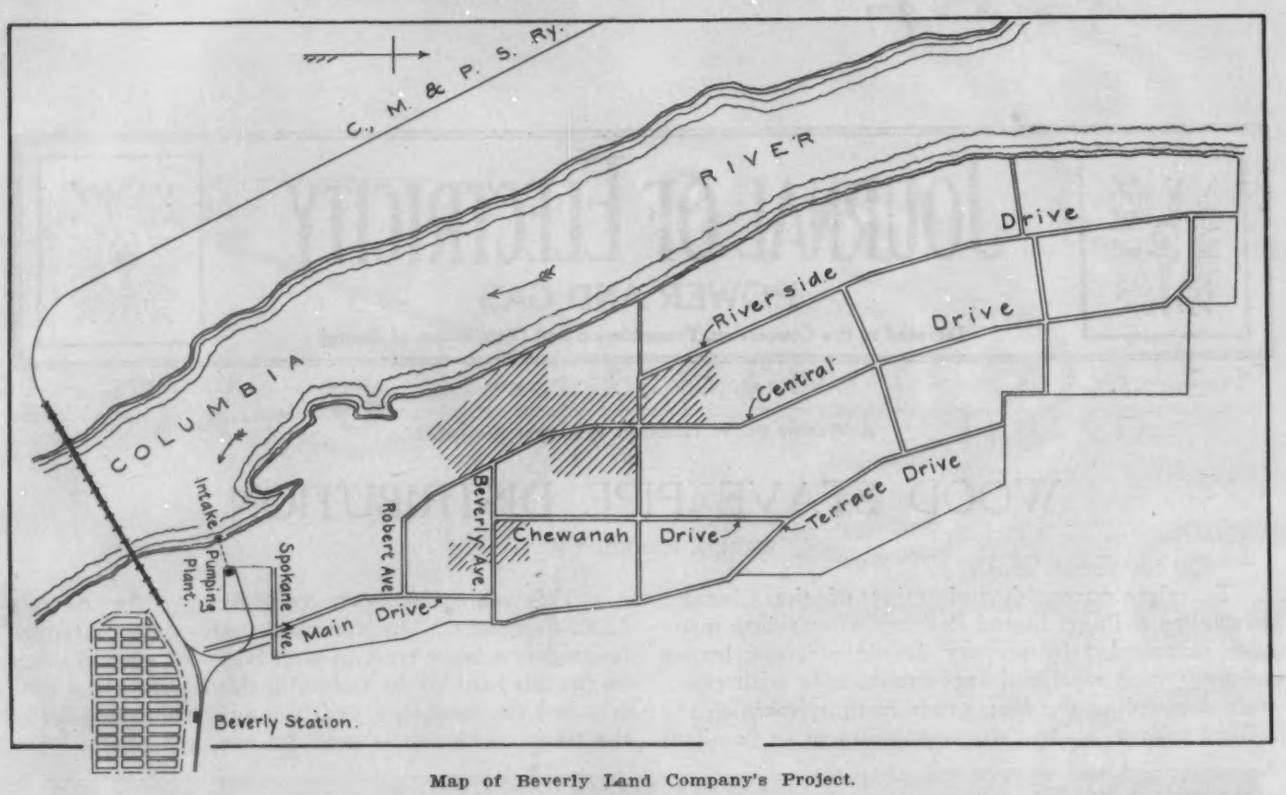
Travelers on east-bound trains of the Chicago, Milwaukee & Puget Sound Railway, after riding many miles surrounded by scenery devoid of trees, brown and gray with sand and sage-brush, note with relief, when descending the long grade leading down to the Columbia River bridge, the appearance of an incipient oasis in the desert. Large patches of green on the land sloping to the opposite bank of the river, indelibly indicate that after various setbacks and changes in the ownership of the project, the irrigation enterprise at Beverly, Wash., is now actually in successful operation.

The combination of a plant of the waterworks pumping engine type, with a pipe distribution system, is as yet unusual in northwestern irrigation, and particular interest therefore attaches to the accompanying illustrations and descriptions.

This plant has been completed by the Beverly Land Company. The pumping equipment is intended to irrigate a large tract of land lying for several miles on the left bank of the Columbia directly north of Beverly and reaching back nearly a mile from the edge of the river. The soil is volcanic ash, and sandy loam, several feet deep, with gravel sub-soil. There is a gradual slope down to the river, giving excellent grades for irrigation. The project was started with a view to developing an orchard region like those which have made famous other fertile valleys of the State, the fruits considered most favorable being peaches, apricots, nectarines, cherries, plums and strawberries. Late winter apples and pears may also be grown.

Making "Buckle" in Wood Stave Pipe.

The irrigation season lasts for six months, from April 1st to October 1st. The average annual precipitation is between seven and eight inches. Water is



Map of Beverly Land Company's Project.

taken directly from the river and pumped into the distribution system, which consists of wood-stave pipe, extending throughout the project. In order to compensate for variations between the amount of water being drawn off through the outlets and the amount delivered by the pump, as well as to provide a certain amount of storage when the pump is not working, a reservoir has been constructed at an elevated point, and a twelve-inch branch from the 26-inch main delivery line permits a flow to and from the reservoir.

The intake is a reinforced concrete structure located in the river, several rods from shore. The various levels of water in the Columbia are as follows:

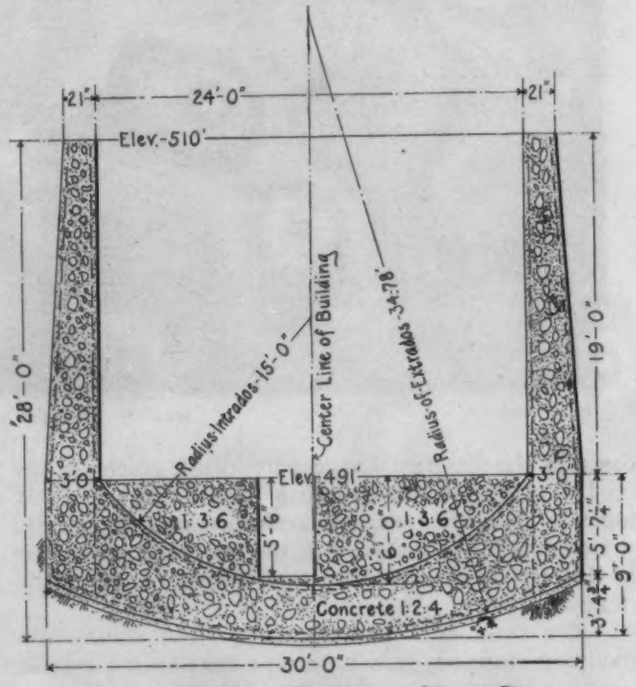
Extreme Low water, elevation above sea	473.4
Ordinary high water, elevation above sea	494.8
Extreme high water, elevation above sea	508.9

The bottom of the concrete footing supporting the intake, which rests in the gravel bottom of the river, is at an elevation of 467.4.

The intake pipe is 30 in. inside diameter, of concrete 3½ in. thick, reinforced by wire mesh, and laid in the gravel bottom of the river with its axis practically horizontal. It extends between the intake structure and the "sand catcher" or settling chamber which forms a part of the pumping plant building. This building is a reinforced concrete structure with wooden roof. It consists of boiler and engine rooms and suction wells or sumps. The boiler room is at the easterly end of plant, with floor at approximately ground level and a basement below, the latter being designed for future installation of a car for removing ashes, if found desirable.

The engine or pump room is 24 x 48 ft. inside. The machinery is all below the ground level, in a pit completely lined with concrete, in other words it sets in a big reinforced concrete tank. The hydrostatic pressure of the ground water made necessary great strength against upward and lateral thrust for the bottom and sides of the pit. To resist this, an inverted arch of reinforced concrete was adopted for the bottom of pit, as shown in the illustration.

The initial steam generating installation consists of one Stirling water-tube boiler built by the Babcock & Wilcox Company at their Barberton works, contain-



Transverse Vertical Section of Pump Pit.
PUMPING PLANT, BEVERLY LAND CO., WASH.

ing 170 tubes 3¼ inches diameter, three steam drums 36 inches in diameter, and one mud drum of same diameter. When the design of the plant was in its early stages, the question of using California oil for fuel was seriously considered. Owing to the railroad freight charges from tide-water, this point is in the zone where the economy of using crude pertoleum is problematical, since coal is produced in the state at a distance of a moderate haul. The plant has consequently

Pumping Plant of Beverly Land Company.

been installed without oil-burning appliances, since coal has been secured for less than three dollars a ton. It is a peculiarity of this region, that, whereas not a growing tree can be seen in the landscape, except where planted, yet there is a large amount of good timber and fire-wood to be had on the banks of the Columbia, as this wood is carried down stream from the giant forests through which the upper portions of this great river flow.

Reinforcement on Bottom of Reservoir.

The pumping engine is of the horizontal cross-compound condensing Corliss type. The operating conditions of the pump are that it should, when supplied with steam having a pressure of 150 lb. per sq. in. at the throttle, pump 6000 gallons per minute (13.3 cu. ft. per second) against a total head of 82 ft., or about 35½ lb. per sq. in. The reservoir was, however, placed in a somewhat different position from that originally contemplated, putting a greater head on the pump, so that the total operating head from mean water level to the reservoir is now 92 ft.

Delivery Line and Distribution System.

The use of a pipe distribution system, with the consequent reduction of seepage and evaporation losses, and freedom in location of the lines, is gradually gaining ground in the Northwest, especially where, as at Beverly, there is such free drainage through the underlying gravel. The project was subdivided with a view to distribution by pipes, generally following the roadways, and the lot boundaries were governed in part by topography, which accounts for their irregular areas.

The delivery line is 26 in. wood stave pipe for a distance of 3502 ft. from the plant to Beverly avenue. This is continuous stave pipe, made in place. From this point 24 in. machine-banded wood pipe runs west and 10 in. machine-banded pipe runs east. There are four main lines, running north on Riverside, Central, Chewanah and Terrace Drives, these being roads extending approximately parallel to the river, the last named being the highest. These lines vary in size, diminishing as they progress northward, being 16, 14, 10 and 8 inches in diameter. The laterals are mostly 6 in. and 4 in. machine-banded pipe, 4 in. being the smallest used on the system. There are altogether 12 miles of wood pipe, all machine-banded except the 26 in.; it was furnished by the Washington Pipe & Foundry Company, Tacoma, Wash.

The 12 in. branch to the reservoir joins the 26 in. line 933 ft. from the pumping plant, and extends thence 2210 ft. in a general northerly and easterly direction to the gate valve at reservoir.

The tracts into which the project is divided, run usually from six to twelve acres in area, though there are some larger ones and a few smaller. Water is led by the distribution system to the highest point of each lot and delivered through a 3 in. wrought iron pipe, rising vertically with an ell on top, the outlet being about 18 in. above surface of the ground.

The typical outlet branch is laid out as follows: A saddle is strapped on the wood pipe, and from the saddle a 4 in. machine-banded wood pipe runs near the riser pipe, terminating at a 4-in.-3-in. reducer, from which a 3 in. wrought iron pipe runs to a 3 in. gate valve. Following the gate valve, with nipple between, is an elbow from which the 3 in. riser conducts the water above the surface. Over the gate valve a 12 in. wood stave pipe is placed, its top projecting a few inches above ground.

Springing into being as a helper engine terminal for the Milwaukee's long grade, it is now possible to forecast Beverly's position as the trade center of a large and fertile region, of which the project herein described is the nucleus.

WIRELESS TO TELL THE EXACT TIME.

The exact time at a given moment in America and Europe will be established shortly by wireless telegraphy. About the middle of November it will be possible for the first time to establish with precision the longitudes of America and Europe in their relation to each other by the exchange of wireless signals between the great station at Arlington, Va., and the Eiffel tower in Paris, and other European stations.

Hitherto European and American time has been established by cable, allowances being made for loss of time in transmission, and it has been fixed only three times—in 1866, 1870 and 1872.

ELECTRICAL PUMPING AND IRRIGATION

PLANNING AN IRRIGATION SYSTEM.

BY B. A. ETCHEVERRY

I.—Preliminary investigations to determine feasibility of system.

The character of these investigations consists of a study of the land, the water supply, the crops and the cost of the system. In some cases the investigations will include a field hydrographic survey and reconnoissance, or even preliminary surveys. The investigations must be as thorough as the importance of the project will justify, but as the feasibility of the project is not at first known, the expenses must be kept down to a minimum.

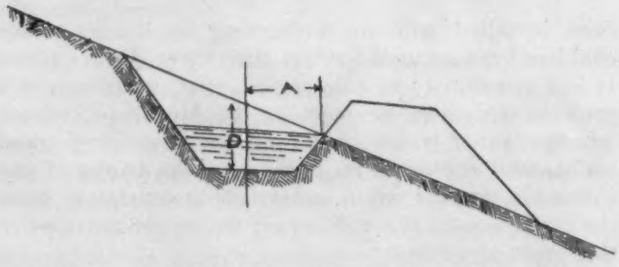
II. Alignment and location of diversion line and headworks.

This will include the following surveys: (1) Reconnoisance survey and trial line surveys; (2) Preliminary survey; (3) Location survey.

Reconnoissance survey and trial line survey. The purpose of these surveys is to determine the possible position of the headworks and the probable position of one or more diversion lines and their relation to the irrigable area. The final selection of the best diversion line in some cases requires the more detailed and accurate preliminary surveys of several of the favorable positions. Where topographic maps are available, such as the U. S. G. S. maps, the reconnoissance survey may not be necessary, and the most favorable position may be found from the map. But even then a rapid trial line survey is usually necessary. The reconnoissance survey will consist of a rapid survey of the various possible lines, in which are taken the elevation, distances and bearings. The elevations are obtained with aneroid barometers, distances are usually measured by stepping and the bearings by a compass. The reconnoissance may be followed by a more accurate trial line survey with level and transit and stadia. Where the character of the country is such that the probable position of the diversion line is pretty definitely indicated, the reconnoissance survey may not be necessary and a few trial lines will give the necessary information to select the best line. In addition to the survey notes the field book should contain general information as regards the character of material in which the canal will be excavated, the slope of the hillsides, the obstructions such as depressions, ridges, etc.

Preliminary survey—The purpose of the preliminary survey is to locate on the ground, as close as possible the diversion canal. This may be done in different ways, depending on the character of the country, (1) by a series of tangents with topography taken for a strip of land on each side, followed by a paper location; (2) by a series of tangents fitted to the ground with the necessary curves without the paper location. The second method differs from the first in that the preliminary survey is combined with the location survey and eliminates the paper location.

The first method of preliminary survey requires a level party and either a transit party or a plane table party. The level party works ahead of the transit or plane table party, setting stakes 300 or 400 ft. apart, or closer if necessary. The stakes are set on the center line of the canal allowing for the grade and for the depth of center cut. The distances which are necessary to obtain the canal grades are obtained sufficiently close by pacing. The depth of center cuts are obtained from diagrams or tables prepared for this purpose and which are kept by the rodman. The level party should carry the grade elevations on profile paper. The center cuts which are given for various slopes of ground may be computed on the basis that the amount of cut will equal the fill which brings part of the water section in fill; or it may be computed so that the water will be all in cut. This is safer on side hills especially, but gives an excess of material for the banks. To use the proper center cut from the tables, the slope at right angles to the canal is obtained by taking rod readings on points 50 to 100 ft. apart on each side of the canal or by using a clinometer carried by the rodmen. The method of computing center cut is described later.



Profile of Ditch With Water Section Entirely in Excavated Earth.

Where the water is to be kept all in cut, instead of using the computed center cut, the center line may be staked out without tables as follows: Locate the stakes at the point where the ground surface and the water surface on the downstream side intersect, the elevation of these points being at a height above the bottom of canal equal to the depth of water in the canal; from each of these points measure horizontally a distance equal to half the width of the canal at the water surface driving the center line stake on the other end of this measured distance.

Where the center cut must be such that the cut will balance the fill, the pivotal point method, used on reclamation projects in Montana and described later, is good.

The transit or plane table party follows the level party, locates the stakes, reads the distances by stadia and takes topography for a strip of land on each side of the level line of sufficient extent to include the final location. When a transit is used, the topography may be taken either by transit and stadia or by topographers using a hand level or clinometer. The level party must not work too far ahead of the transit party in order that the errors made in estimating the distances on which the allowance for grade is made will not become too large.

The results obtained are mapped and the final location made on the map and transferred to the ground.

The second method of preliminary survey combines the preliminary survey and field location survey and is well adapted to rough country. It has the advantage that it fits the canal to the irregularities of the ground very closely. For this method the work

Hillside Ditch Construction.

of the level party is the same as for the first method described above, except that the grade stakes are located at every station (measured by stepping) and at every controlling point. This work is important and it may be better for the chief of party to act as rodman.

The transit party carries tables of tangent offsets, external secants, semi-tangent lengths, etc. The locating engineer runs tangents which will fit the stakes or flags set by the level party, straightening out the irregularities, moving as many stakes above the new lines as below it so as to keep the proper balance between cut and fill within the limit of economic haul. Stakes are set 50 ft. apart and the head chainman proceeds until he comes to the P. I., which is selected by the chief of the party, by sighting along the approximate position of the tangent ahead. From the central angle and the lay of the ground the transitman selects the degree of the curve; the semi-tangents are then measured off, the P. C., and P. T. are set and the curve is run by tangent offsets.

The final profiles of the stakes set by the transit party are taken by the level party, which may be the same level party that proceeded the transit party or a second level party, when the transit work can keep up sufficiently close to the level party ahead. In taking the final profile, all depressions and also the slope of the ground at right angles to the canal line are recorded in the notes. The final profile and alignment are turned over to the field draftsman and estimates worked up. This will serve as a basis to let contracts until the line is cross sectioned.

The locating engineer should select the most economical and best location for structures and make notes as regards the best type of structure. Special topography is taken at these points. Where ridges or depressions must be crossed or where a saving in length may be obtained by not following the contour, profiles of the different lines and sufficient topography must be taken to select the most economical construction.

The character of the material must be determined by test pits or borings; for this a testing party may be necessary.

Paper location and field location survey—When the second method of preliminary survey is used it combines with it the field location. The paper location is therefore omitted. When the first method of preliminary survey is adopted the paper location is made after the preliminary line with the topography has been plotted. The paper location will be made by adjusting the tangents and curves to the topography; also by a study of the map and profiles of the trial lines placed on the map, so as to obtain the required amount of excavation, which may be the amount necessary to balance the fill, or the amount necessary to bring the water section all in cut, depending on the form of construction adopted.

The field location consists in staking out the center line of the paper location. The transit party stakes out the tangents introducing curves and ties in with the preliminary line at the intersections. The level party follows the transit party and runs a profile of the center line. From this profile and the elevation of the grade line,, the depth of cuts or fills are obtained and the line is ready for the cross sectioning of the construction survey.

III. Location of distribution system.

The location of the distribution system is generally preceded by a trial line survey of the upper boundary line of the irrigable area, which will probably be the position of the main canal, and of the lines on the ridges which the main laterals will probably occupy. This survey is mainly to determine the general feasibility of the distribution system. To plan the system it is best to have a complete topographical contour of the entire irrigable area. The topographical survey is usually based on one of the three following systems: (1) a triangulation system consisting of a base line carefully measured and of controlling points forming a system of triangles which will control the topographic survey; (2) a system of traverses run

Ditch Construction in Comparatively Level Country.

with transit and consisting of lines located on the upper boundary of the irrigable area on the ridges and drainage lines and connected by cross lines; (3) the U. S. land survey system. These three systems are only the skeleton controlling the topographic survey. When these systems have been established, lines of levels are run to obtain the elevation of each point. The details of the topography are obtained either with transit and stadia or with plane table; the latter is

usually preferable. The points of the system with their elevation are plotted on the plane table. Additional traverses are run where necessary and the topographic details located and plotted. The map should be made on a scale of not over 1000 ft. to the in. The contour intervals will depend on the character of the area. Where the slope is regular and fairly steep 5 to 10 feet is satisfactory. Where the slope is irregular with more or less knolls, or where the slope is flat, 1 foot contour interval is desirable.

The completed maps will give all the necessary information for the paper location of the distribution system and drainage system. Care must be used in laying out the system so that the water will be delivered at the highest point of each farm and if possible, at least 6 inches or 1 foot above this point. The laterals should all terminate in a waste or drainage channel. The paper location is followed by the field location, modifying the paper location where necessary. Levels are then run on the located lines and profiles plotted. With these profiles the cross sections, the grades, and the depth of cut, are adjusted to give the necessary cut and fill as explained later.

IV. Office work.

The office work will include:

1st. Design of canal sections and structures.

2d. Preparation of tables and diagrams for field work, such as tables of semi-tangent lengths; tables of tangent offsets, diagrams showing cross sections of canals with the yardage in embankment and in excavation for various slopes of hillsides; estimated cost per lineal foot of different forms of cross sections in different materials; of siphons, flumes and tunnels.

3d. Plotting of maps and profiles.

4th. Earthwork computations and cost.

5th. Bill of materials of structures and cost.

6th. Specifications.

V. Construction survey.

This includes the cross sectioning of lines, the staking out of earthwork and the location of structures.

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Some methods and cost of contour surveying in winter, by H. G. Rashbacher, Engineering Record, Nov. 25, 1911.

Field Location of Canals for Engineers, Wisconsin Engineer, February, 1910.

Field Work in Locating Irrigating Ditch, Engineering News, May 26, 1910.

Canal Location in Uniform Countries, by Lyman E. Bishop, Proceedings of the Amer. Society of C. E., August 1911, October, 1911.

Methods and Cost of Making Sub-divisions on Topographical Survey for Sunnyside Unit, Washington Engineering Contracting, June 12, 1912.

Flow of Water in Irrigation Canals.

Velocity in canals—The principles of flow in canals are:

1st. In any canal where there is a uniform flow the two factors affecting the flow are the resistance of friction and the accelerating force; these two factors are equal, otherwise acceleration would occur.

2d. The resisting friction is proportional to the square of the velocity, the area of canal in contact with water, and the density of the liquid.

If F = Accelerating force parallel to canal grade.
F' = Friction resisting force.
S = Area of surface in contact with water.
d = Density of liquid.
p = Wetted perimeter.
a = Area of cross section.
$\frac{a}{p}$ = hydraulic radius = r
l = Length of canal considered.
h = Fall in length l.
W = Weight of water in length l.
C & C_1 = Constants.
s = Grade.

Then $F' = CSdv^2$; But $S = pl$; therefore $F' = Cpldv^2$

$\frac{F}{W} = \frac{h}{l}$ or $F = \frac{Wh}{l}$. Since $F = F'$, $\frac{Wh}{l} = Cpldv^2$

and $v^2 = \frac{Wh}{Cpl^2d}$; But $W = ald$, therefore $v^2 = \frac{aldh}{Cpl^2d} = \frac{1}{C}\frac{h}{l}\frac{a}{p}$;

$v^2 = \frac{1}{C} Sr$; $v = \sqrt{\frac{1}{C}}\sqrt{rS} = C_1\sqrt{rS}$ (*Chezy Formula*)

RESULTS OF THE CAREY ACT IN OREGON.

Admitting that so far Oregon's operations under the Carey act have not been very successful, the sixth biennial report of the Desert Land Board to the State Legislature has been completed and approved so far by the Governor, but has not been examined by all the other members of the Board. The report shows that a little over 500,000 acres of land in Oregon are now affected by the Carey act.

"Part of this land has been satisfactorily reclaimed, part is under contract for reclamation and part is temporarily withdrawn for investigation.

"The average value of this land, when irrigated, is at least $30 an acre. If the Board succeeds in having all of this area reclaimed it will add $15,000,000 in land to the taxable area of the state, besides bringing in a large number of people who will make their homes on these farms. Moreover, the state is entitled to an additional 500,000 acres of vacant desert land, under the Carey act," states the report.

"It must be admitted that Oregon's operations under the Carey act have not as yet been very successful. This is due to an unfortunate beginning. This state accepted the Carey act in 1901, but the act of acceptance did not give the State Land Board sufficient authority. Nearly all of our present projects were initiated between 1901 and 1905. There was no state engineer at that time to advise the Land Board relative to the engineering problems involved, and the parties initiating the projects did not seem to realize the importance of obtaining complete and reliable information relative to water supply, duty of water and cost of reclamation. The result was that the amount of available water was grossly overestimated, or the amount necessary to reclaim the land underestimated, or the cost of applying the water greatly underestimated.

"In 1909 the present law accepting the Carey act was passed placing the control of the Carey act lands in the Desert Land Board. It is believed that during the past two years the Board has been very successful in its efforts to readjust the earlier mistakes and that the Carey act projects of the state are now in better condition than ever before."

In its recommendation to the Legislature the Board asks for an appropriation of $10,000. The report states that a competent engineer for field inspection and work should be in the steady employment of the Board.

RATE FIXING AND APPRAISAL

Rates of Return and Value.

BY C. L. CORY.

It is self-evident and repeatedly expounded that in the determination of reasonable rates of service, both the reasonable rate of return, including interest and profit and a fair valuation of the property used and useful in the service of the public, must be established.

As indicating some of the elements entering into the determination of what is a reasonable rate of return, reference is here made to the report in 1911 of the Railroad Securities Commission, of which President Hadley of Yale University was chairman. What is said there regarding the railroads of the country applies equally to all public utility enterprises.

"We hear much about a reasonable return on capital. A reasonable return is one which, under honest accounting and responsible management, will attract the amount of investor's money needed for the development of our railroad facilities. More than this is an unnecessary public burden. Less than this means a check to railroad construction and to the development of traffic.

"In no event can we expect railroads to be developed merely to pay their owners such a return as they could have obtained by the purchase of investment securities which do not involve the hazards of construction or risks of operation.

"Your commission recommends that the Interstate Commerce Commission should have authority and adequate funds to make a valuation of the physical property of railroads wherever the question of the present value of these roads is of sufficient importance. It is hardly necessary to add that your commission does not believe that the cost of reproduction of the physical properties, however carefully computed, is the sole element to be considered in determining the present value of a railroad, or that the outstanding securities could or should be made to conform to any such arbitrary standard.

"It is quite possible that the building of additional railroad mileage will be far less rapid in the future than it has been in the past, but the capital needed for the development and the improvement of the mileage already existing is enormous, even if we built no new mileage at all. Neither the rate of return actually raised on the par value of American railroad bonds and stocks today, nor the security which can be offered in the future will make it easy to raise the needed amount of capital."

Although you are familiar with the decision of Justice Peckham of the United States Supreme Court in the case of the Consolidated Gas Company of New York, reference is also here made to the following extract from this decision, as having unquestionably the most direct application to the rate of return for gas companies in large cities, although the question in this case was not the determination of the reasonable rate of return, but rather whether or not a certain rate of return would be enough to avoid the charge of confiscation.

"There is no particular rate of compensation which must in all cases and in all parts of the country be regarded as sufficient for capital invested in business enterprises. Such compensation must depend greatly upon circumstances and locality; among other things, the amount of risk in the business is a most important factor, as well as the locality where the business is conducted and the rate expected and usually realized there upon investments of a somewhat similar nature with regard to the risk attending them. There may be other matters which in some cases might also be properly taken into account in determining the rate which an investor might properly expect or hope to receive, and which he would be entitled to, without legislative interference. The less risk, the less right to any unusual returns upon the investments. One who invests his money in a business of a somewhat hazardous character is very properly held to have the right to a larger return, without legislative interference, than can be be obtained from an investment in government bonds or other perfectly safe security. The man that invested in gas stock in 1823 had a right to look for and obtain, if possible, a much greater rate upon his investment than he who invested in such property in the city of New York years after the risk and danger involved had been entirely eliminated.

" In an investment in a gas company, such as complainants, the risk is reduced almost to a minimum. It is a corporation which, in fact, as the court below remarks, monopolizes the gas service of the largest city in America, and is secure against competition under the circumstances in which it is placed, because it is a proposition almost unthinkable that the city of New York would, for purposes of making competition, permit the streets of the city to be again torn up in order to allow the mains of another company to be laid all through them to supply gas which the present company can adequately supply. And so far as it is given us to look into the future, it seems as certain as anything of such a nature can be, that the demand for gas will increase, and, at the reduced price, increase to a considerable extent. An interest in such a business is as near a safe and secure investment as can be imagined with regard to any private manufacturing business, although it is recognized, at the same time, that there is a possible element of risk, even in such a business. The court below regarded it as the most favorably situated gas business in America, and added that all gas business in inherently subject to many of the vicissitudes of manufacturing."

It may be of value to indicate some of the factors entering into the determination of a fair return upon capital invested in public utility companies and also to enumerate specifically some of the risks to which the investment in many public utilities are constantly subject.

The return upon the investment required by a public utility corporation is itself the sum of four elements, the first three pertaining to what is generally known as interest and the fourth as profit, as follows:

(1) Rental on money thoroughly well secured;
(2) Insurance to cover risk of loss;
(3) General expense involved in obtaining money and providing for periods of idleness when such money is not invested;
(4) The return to the owners of the property for their proprietary supervision and initiative actions, which return is true profit.

In any given community the rate of interest varies mainly because of variations in items (2) and (3). If

money absolutely secured against loss commands 5 per cent, item (1) is 5 per cent. If the insurance risk is 1 per cent, and if the cost of obtaining the money is 1 per cent, the total interest rate is 7 per cent. The farther a property is from the large money markets, the larger do items (2) and (3) become. Hence mere interest rates on the Pacific Coast are considerably higher than in the East.

The item of risk (2) rises as the amount loaned becomes a higher percentage of the value of the security. If the money can be borrowed at 7 per cent on a loan that is, say, three-fourths the market value of the property, there is a margin of security in the remaining fourth that has operated to reduce the item of risk, (2). If, however, it is desired to borrow money up to the full market value of the property, 8 per cent or more may be the interest rate, for item (2) has necessarily become greater.

It will be noted that nearly every loaner of capital assumes some risk, and charges interest rates accordingly. The borrower who uses the capital assumes the risk of being able to earn a profit, but his risk is provided for in the percentage of gross earning that it is estimated he should earn.

It has sometimes been asserted that there is practically no risk either on the part of the loaner of capital or on the part of the owner who uses the capital to build and operate a public utility. However, there are few utilities that are operated without risk. Twenty odd years ago gas lighting companies seemed to be safe against losses, but electric lighting has been developed to such a degree that many gas companies are not earning bare interest rates on the cost of their property. There is, in fact, no plant on earth that is safe from possible loss of earning power, so long as inventive genius exists and continues active, for a new invention may, at any moment, change completely an entire industry.

A public utility in a small town or city is subject to many risks, some of which it may be well to enumerate:

(1) Competition from other utilities whether privately or publicly owned.

(2) Stagnation in the growth of the town or city, causing loss of return on a plant built to provide for, and assist in, effecting growth.

(3) The passage of laws and ordinances injurious to existing business.

(4) Financial panics that deprive people of the means with which to pay for ordinary utility services.

(5) Great fires, floods, tornadoes, earthquakes, strikes, war, and other causes beyond the control of the utility company.

(6) Regrading of streets, extensive paving and other public expenditures, the burden of which a utility company must share either through direct assessment or through taxation.

These and other causes often make the risks of a utility company very considerable. The smaller the city or community, the greater the risk. Even when a public service commission fixes a rate of "fair return" the risk is not eliminated, for it may not be feasible to secure a fair return.

In recognition of all these things, the tendency of public service commissions and of courts has been toward allowing higher rates of return than were at first regarded as sufficient for a public utility to earn.

Judicial and commission decisions consistently and repeatedly rendered, have established the soundness of the principle, and the necessity, that the "value" of any enterprise of any character must include, in addition to the physical property actually used and useful in rendering service, the "going value" or the "value of the going concern." Such intangible value over and above the physical value may be referred to by a number of different names, but in every case, it is to be considered as the difference between the value of a physically complete and practically perfect plant or system ready for operation but not in operation, ready to give service but not giving service, ready to earn an income, but actually earning no income whatsoever, ready to enter into long or short term contracts with customers or consumers, but actually having no contracts of any kind with any consumers, at the end of the construction period but as yet with no business at all, and the value of this plant at some later time when business has been developed and perhaps firmly and permanently established, with many contracts, some for long terms and of greater or less value, with customers connected and receiving and paying for service, possibly in a progressive territory where the enterprise in question has in the past assisted, and is at present assisting materially in the general advancement of the community.

Viewed from a different standpoint, it may be supposed that the owners of such an enterprise are willing but are not compelled to sell, and a prospective purchaser is desirous, but not forced to buy the plant, system and business. Then the amount which such a prospective purchaser would pay the owners over and above the value of the physical property only, is unquestionably the going value of the enterprise. While the above statement must unquestionably be accepted as having been actually confirmed in numerous transactions, it is difficult in most instances to establish sound principles which may, with confidence and fairness, be used to determine in definite figures the going value of an enterprise and particularly of a public service corporation under the control of any public rate fixing (and quality of service) commission.

One element of going value which is quite generally accepted is the "Cost of Developing Business" or the "Development Expense," and if the aggregate of the various items, which are properly a part of the development expense, is not inconsistent with the value of the business actually obtained and held by the company, then the going value and development expense have a close relation in actual figures one with the other.

But it must be remembered that "cost" and "value" are not necessarily equal. "Cost" may be greater than "value" under disadvantageous conditions while "value" may be, and often is, many times the "cost" under decidedly favorable conditions. But if sufficient data and records are available in any given case, so that the development expense can be reasonably accurately obtained, and the management has been to a large degree wise and economical and good judgment has been shown, there is probably no more accurate or fair method available to obtain the "going value"

than its determination from the actual cost of building up and establishing the business.

The items which properly should be included in the development expenses are:

1. The difference if any between a "fair return" on the "value" of the property during the first years of its existence, or during the development period, and the actual return, tabulated by years and until such time as it may be said that the business is established to such a degree as to be earning a fair return on the investment, including the interest which the business has failed to earn, taking each year by itself.

2. All actual costs directly related to the securing of business such as advertising soliciting, unremunerative concessions to prospective customers, such as gifts, selling accessories below cost, maintenance of amusement parks to increase business, providing, of course, such costs are bona fide expenses over and above the direct revenue which may be obtained therefrom.

3. The cost of developing a competent business organization for the purpose of developing business, but this cost must not also be included in the general annual cost of maintenance and operation.

4. All the expense in the past history of the company which has been necessary and unavoidable in modifying the character of the system as a result of rapid changes in the art or abnormal growth of demand for service and which were required for the most economical operation and growth of the business, unless all such expense has been previously taken care of by an annual allowance for depreciation, obsolescence and inadequacy resulting from such modifications of the system.

Where a public utility enterprise has a number of departments such as electric light and power, gas and electric railway service, it would seem best in computing the development expense to consider each department separately from the time service was first given in each department, but in applying the final aggregate of all departments, if there should be a surplus in one or more departments, such surplus might be very properly considered as off-setting or tending to balance the inadequate return in one or more of the other departments.

In my opinion the statement that past "deficits" in the operation of the business should be combined and used as a measure of the "going value" is not only unfortunate, but decidedly misleading. Interest during the construction period might quite as properly be termed a "deficit" in return on the investment during the construction period, because the money expended during the construction period does not earn ordinary rates of interest during the construction period.

During the development of business period, the difference between a fair return and the actual return cannot properly be called a "deficit," but represents in reality an additional sum which investors should be prepared to put into the enterprise, over and above the cost of the physical plant, and continue to do so until the system is firmly established and consists of two main parts—the physical plant and the business actually being done at a real profit over and above legitimate maintenance and operating costs.

The word "deficit," while undoubtedly it should not be so interpreted, is unquestionably many times understood as implying uneconomical and unwise management, or the lack of reasonable foresight and good judgment, both of which qualities should be possessed to a considerable degree by those in control of all public utilities upon which the people are compelled to depend for proper and reasonable service at rates as low as are consistent with all the existing conditions.

It is, therefore, in some instances preferable to avoid the use of the word "deficit" in connection with "development expense," and obtain the going value by assuming that all expenditures in developing the business up to the time that a fair return is earned on the investment, should be added to the physical value of the system in order to arrive at the total value of the entire system in successful operation as a going concern, giving satisfactory service to its customers.

Necessary expenditures to develop business bear identically the same relation to the development period as interest during construction bears to the construction period.

THE ECONOMY OF CORPORATIONS.

BY JOHN OTTO.[1]

Down at the root of the things which make for the economic management of our public service corporations, and giving them one of their greatest advantages over municipal enterprises, is their ability to purchase material for construction, maintenance and operation cheaper than the same commodities can be purchased by untrained and short-termed political office-seekers. Ask the bonding companies for the percentage of corporation purchasing agents who have been delinquent in their accounts or have accepted money or its equivalent with whom they have had dealings, and they will tell you that the total of dishonest buyers for corporations is but a small percentage of the whole.

The purchasing agent of the corporation usually begins his career in minor positions of his employer and by the slow processes of loyalty, honesty, integrity, and ability which result in recognition, reaches a point where his employer is willing and warranted in entrusting him with the purchasing of millions of dollars worth of material and in relying absolutely upon his judgment.

Among the duties of the purchasing agent is to be reasonably familiar with every class of material which is required by his company, relying upon the opinion and recommendations of the engineers as to technicalities. This is an undertaking which requires constant vigilance with a company where ramifications of its purchases reach into the millions.

A purchasing agent for a company of this size and character must, to a certain extent, have a general knowledge of all the material in the market for which he has occasion to buy. He should know, for instance, the product of timber, wire and cables, poles, crossarms, transformers, meters, etc.

It is necessary for the purchasing agent to know the trend of the market on copper and its products, thus making it necessary for him to keep in touch with the market quotations on the raw material, also to keep himself advised as to the output of the mines, and the total consumption of finished product and the amount of raw material carried in the market. To illustrate: We purchased in November last two million pounds

[1]Purchasing agent, Southern California Edison Company.

of No. 4/0 stranded copper wire at approximately $14.25, whereas at the present time we would have to pay about $18.25. About the same time this order was placed several other orders were placed in this country and in Europe for like amounts, which, coming as they did when the copper market had been quiet, caused by inactivity in the electrical industry, at once caused prices to advance.

The above will show how necessary it is for the purchasing agent to keep himself posted on the prevailing market conditions.

In the placing of orders price does not always govern, as quality is the first thing to be considered. The second matter of importance is delivery. For instance, if an important extension had been passed upon and the operating department had been instructed to see that this work be started and finished at the earliest possible date in order to enable us to take on a very attractive piece of business, we would be largely

John Otto.

swayed in the placing of orders for the necessary material by the delivery we could secure. We might receive a quotation from some Eastern concern where the price would be, say, $100 less than we could purchase the same material for in the local market, but it might not be advisable to take advantage of the Eastern price for the reason that the amount involved would be so small as compared with what the revenue would be to the company and the good-will the consumers would have for us by virtue of our promptness in serving them.

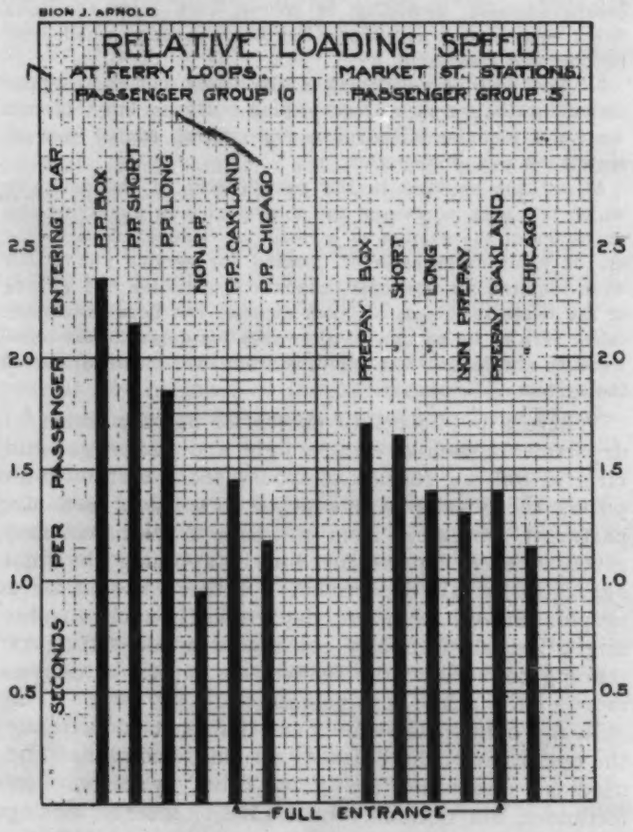
On the other hand, the purchasing agent of the municipal plant might be governed more or less by henchmen or political influences, and it could hardly be expected of him to show the same interest, as one associated with a corporation where the officials and department heads work in unison and harmony for the upbuilding and solidity of the company of which they consider themselves a part. If this spirit did not obtain it would seem to me impossible to build up the very large interests that are so numerous in this country, which all demonstrates beyond a doubt that where these influences are so prominent success will, of necessity, be the result.

SAN FRANCISCO'S TRANSPORTATION PROBLEM.

Relief of Traffic Congestion on Lower Market Street.

Bion J. Arnold's Preliminary Report No. 6 to the San Francisco Board of Supervisors is devoted to a consideration of ways and means for the immediate relief of the traffic congestion on lower Market street.

Detailed consideration is given to the following subjects: Traffic regulation; car and passenger distribution; location and sources of transit delays; street capacity; loading speed; physical obstructions; intersecting lines; arrangement of tracks; safety stations; assignment of stops, present, proposed and alternative; shelters; ferry loop traffic.



This report relates to the physicial conditions and the operative problems only, and has no bearing whatever upon any question of franchises or litigation involving the outer tracks in lower Market street.

Summary of Recommendations.

Encourage and extend the work of the traffic force.

Reserve, for heavy vehicle traffic, one street through the Mission parallel to Market street, and one or more crossing Market street through the wholesale district.

Right-of-way should be determined by relative amount of pedestrian and car traffic at important intersections.

Reduce car traffic crossing Market street throat during rush hours to a minimum, e. g., First street.

Average loading speed of cars must be increased.

Use both ends of the cars at the Ferry for loading, at least, during periods of maximum travel.

Rearrange safety stations with seats elsewhere than opposite entrances and exits.

Extend stations to accommodate two cars at designated points of heavy travel.

At the heaviest traffic points—Third street and Fourth street—two cars should berth and cross together, tandem fashion.

Establish only "near side" stops within the business district.

Distribute stops as uniformly as possible to permit rapid running.

Eliminate as many unnecessary or special stops as may be consistent with the varying local demands of passenger travel.

Out-bound stations are more necessary than in-bound; the latter are only required within districts where ferry travel originates.

Avoid out-bound and in-bound stations located in opposition position.

Designate all stopping points definitely by fixed signs.

No considerable increase in the use of the inner tracks on Market street can be recommended under present conditions and routing.

Use of outer tracks should be limited to preserve the proper ratio of car traffic on inner and outer tracks. Minimum headway, 45 seconds.

Four-track plan A, best suited to immediate needs, is recommended.

Establish definite rules for stops with regard to cars passing on parallel tracks.

Commence proceedings for the recession of the protruding corner of Sacramento and East streets.

Water-front terminal will require modification to better fulfill the fluctuating demands of ferry traffic.

THE INDUSTRIAL ENGINEER.

BY A. J. TURNER.[1]

The question may be asked,—What is the field of the Industrial Engineer?

This query may be answered by calling attention to the marked advance made in engineering in the last ten years, calling for more branches and specialization. Hydroelectric plants, having large amounts of electric current to sell, brought into existence the "Industrial Engineer," whose duty it is to study all power requirements so as to secure customers, improve load factors on generating stations, and keep the power company and customer in close touch with each other, to the end that high efficiency may be maintained.

In studying conditions where power is being produced by a prospective customer, it is the duty of the industrial engineer to segregate all the items entering into the total cost for power produced, test the plant for variation in power demand, if necessary, and determine what load curve is to be expected for the class of work it is called upon to perform during its operating period. In this manner the actual and not supposed power cost is secured and substantial saving shown by the purchase of "Electric Service."

Take, for instance, the production engineer, who operates so successfully in the eastern states; he works turing cost with the direct object of eliminating all unin a similar field, subdividing each and every manufacnecessary duplication of operation and correction of losses. What the production engineer is to the large industrial concern, the industrial engineer is to the central station. To illustrate how cost per unit of produced power by an isolated plant must be determined, the different factors entering into the same are given as follows: Fuel, labor, repairs, water, lubricating oils, supplies, rent, interest, depreciation, insurance, fire, boiler and liability, and taxes.

Often, one reads of a plant producing a horsepower or a kilowatt hour for a fraction of a cent. It is true in most every case that this refers to the cost of fuel only, and only then on a full load rating of the plant. How much attention is paid to the character of load curve on the plant which determines the average power produced. The industrial engineer must study each of the above items, which have a direct bearing on the ultimate cost and may be discussed each in their exact relation.

Fuel—Fuel, the first item, varies in cost according to supply and demand, location and quantity. The variation in load on the prime mover changes the overall efficiency and requires a larger amount of fuel to be used.

Labor—Again the load factor enters into consideration and determines the unit cost of labor per horsepower. If the unit cost of labor at 100 per cent load factor is one cent at 50 per cent it would be two cents per horsepower hour.

Repairs—This item of repairs varies materially and is not usually kept as a separate charge in which case it does not appear in the total cost of power.

Water—The cost of a water supply, whether purchased or pumped, should be taken into account. If a well is bored and a pump installed the amount spent for it should be charged to plant cost.

Supplies—Supplies, lubricating oils, waste and special tools receive small attention and should be rightly charged to produced power.

Rent—The space occupied by the power plant bears a portion of the total rented or owned portion and is very seldom considered. How well this space could be used for manufacturing purposes and the added revenue is not considered, as it should be from an actual business standpoint.

Other Important Items.

Interest—The amount of money invested in the power plant should earn an amount equal to that which it would return if it were in bonds. In fact if used in another business it might return a better revenue.

Depreciation—The life of the plant in question may be anywhere from ten to twenty years and a certain sum of money should be put by each year so that at any given time there may be sufficient money in a fund to keep the original investment in tact.

Taxes and Insurance—These items are justly chargeable to the unit cost of power produced. Insurance may cover that due to fire, boiler and liability for accidents. These important items are considered as fixed charges and represent amounts as follows:

Interest	6 to 7 per cent on first cost of plant
Depreciation	5 to 8 per cent on first cost of plant
Maintenance	2 to 3 per cent on first cost of plant

[1] Industrial Engineer, Great Western Power Company.

Taxes and insurance	1 to 2 per cent on first cost of plant
Liability insurance	1 to 2 per cent on first cost of plant
	15 to 20 per cent on first cost of plant

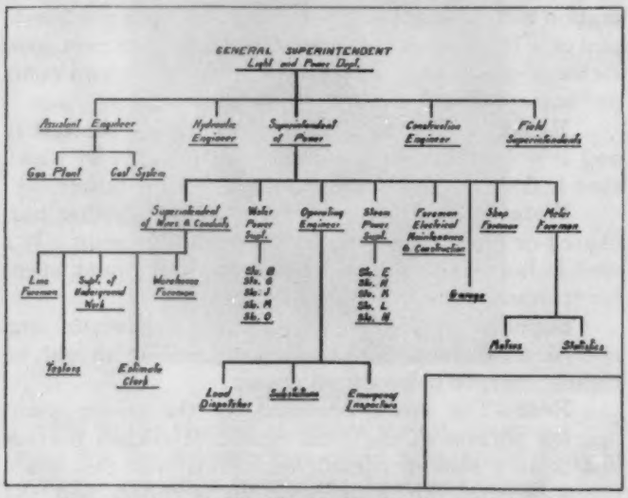
The above are not variables, but are constant, working each hour of the twenty-four in the day for the entire year.

When considered in terms of working hours, their importance will be admitted, as for instance, in an operation period of eight hours per day the fixed charges per unit of produced horsepower will be three times that of a plant operating twenty-four and others in proportion.

Few plants have a very good daily (24 hours) or operating time load factor, in which case the fixed charges per unit of horsepower is increased.

SCIENTIFIC ORGANIZATION OF POWER COMPANIES.

In the present day agitation looking toward maximum service at minimum cost the scientific organization of those making up the directing force is of paramount importance. The Northwest Light & Power Association through their committee on scientific operation of a central station has done much during the past few months to collect together material for future comparative study. The principles of efficiency are of small help unless there is an organization to carry them into effect.



Organization of the Portland Railway, Light & Power Company.

The outlines of the organization of the companies represented bring out two different ideas.

In the one case the entire light and power department is in the hands of the general superintendent of light and power. He is reponsible directly to the president of the company for all construction, maintenance and operation of the light and power department. In the other case the engineering department under the chief engineer, has charge of the engineering part of the work, and reports directly to the president. By that arrangement the engineering department has full charge of the construction work of the company. In this plant, the operation of the system is under the direction of the superintendent of power, who reports to the general manager, and the general manager to the president. This form of organization draws a sharp line between construction and operation.

Among the advantages and disadvantages of each system may be mentioned the following points:

With one head there is a unity and strength that cannot be secured when the organization is divided; any two men are bound to have a variance of opinion at times, and there cannot help arising circumstances where there will be a difference between the two departments which would not occur if all were under one head.

On the other hand, the qualifications of a good construction man are quite different from those of a good operating man; the combination of qualities in one man is rare. The best operating men are those who, by long experience, are thoroughly familiar with the details of operation, are good judges of men, and have also the qualities of leadership and understand the prime essentials of economy and efficiency in the use of materials and men. The best construction men are those who have a good combination of energy, practical experience and training, and who have the special qualities required in engineers, of system, breadth of view and independence of thought, tempered with good judgment. Then, too, the methods of handling and requirements are so different in construction from those in operation that they have to be kept practically separate anyway. In the railroad business, the engineering department is almost always separate from the operating department.

In all the companies from which the statistics have been secured for this paper, the generation, transmission and transformation of power is in the hands of one man who is variously designated as superintendent of power or of stations.

In the Portland Railway, Light & Power Company the superintendent of power has charge also of the distribution, so that to him report all the men in the different processes of supplying the power from generation to point of consumption. To him report the superintendent of water power plants, the superintendent of steam power plants, the operating engineer, who has charge of the load dispatchers and the substations, the superintendent of wires and conduits, the shop foreman, the electrical construction foreman, the meter foreman and the foreman of the garage. He is practically superintendent of operation. The Portland system differs from the others in having a superintendent of water power plants and one for steam plants, instead of having the engineer of each plant report directly to the superintendent of stations. This plan has worked well in securing lower labor costs and satisfactory operation, as it makes possible the securing of men who, by long experience, are familiar with every phase of operation in their line.

There is not much difference between the various systems in the organization of the forces in the generating plants and substations. The Pacific Power & Light Company has a system that is different from the usual three shifts. A chief engineer is on duty for four hours, and two operators on duty ten hours each. The only objection to that arrangement would be the long hours the operators have to be on duty continuously.

ELEMENTS OF HYDRAULIC ENGINEERING

Francis Turbine Runners.

BY GEORGE J. HENRY, JR.

The unit speeds and capacities for Francis runners determine at once the class to which the runner belongs and the characteristics of the runner design.

It is obvious from what has gone before that the unit speed n_1 has the greatest effect upon the diameter and that the unit quantity Q_1 determines the area of the passageways; also with a given runner diameter that for different values of Q_1 we must have different widths of runner buckets or passageways.

It will be more convenient, however, to refer the runner design to the unit quantity Q_1, bearing in mind that the passageways must be provided for a water quantity such that when all allowances have been made for losses we must still have the requisite power output. If, therefore, we require a power output of H.P. under the head h, the same runner (by formulae 23) would give under 1 ft. head $H.P._1 = \frac{H.P.}{h^{3/2}}$, and if we put $H.P. = \frac{Q \times 62.4 \times h}{550} = 1$ if $h = I$ and Q_1 becomes $= \frac{550}{62.4} \times \frac{8.83}{\mu}$ (at 100% efficiency), or we may write

$$Q_1 = \frac{H.P._1 \times 8.83}{\mu} = \frac{H.P.}{h^{3/2}} \times \frac{8.83}{\mu} \quad \ldots . (27)$$

Where H.P. is the horsepower desired at head h and μ is the efficiency we propose to attain, then we must design the runner for Q_1 at unity head and with a corresponding n_1, already determined, we can at once by the curves in Fig. 26 select the proper runner.

The several types of runners may be classified for purposes of comparison as A, B, C, D, E and cross sections of these showing the water passages are shown in a general way in Fig. 27 to 31 inclusive.

The range of specific speeds and efficiencies that may safely be expected are also given and photographs of actual finished runners are shown in Figs. 32 and 33. The slow speed runner shown in Fig. 32 is that in use at the Borel Station of the Pacific Light & Power Corporation and is very similar to that in use in the Centerville Station of the Pacific Gas & Electric Corporation, while that shown in Fig 33 is for a high speed lower head unit. These show at a glance the wide range of design for which the Francis type of turbine is adopted.

Runners of the C. D, and E types may be made double over a large range, over which the speed and efficiency expectation remains the same which the Q_1 is doubled.

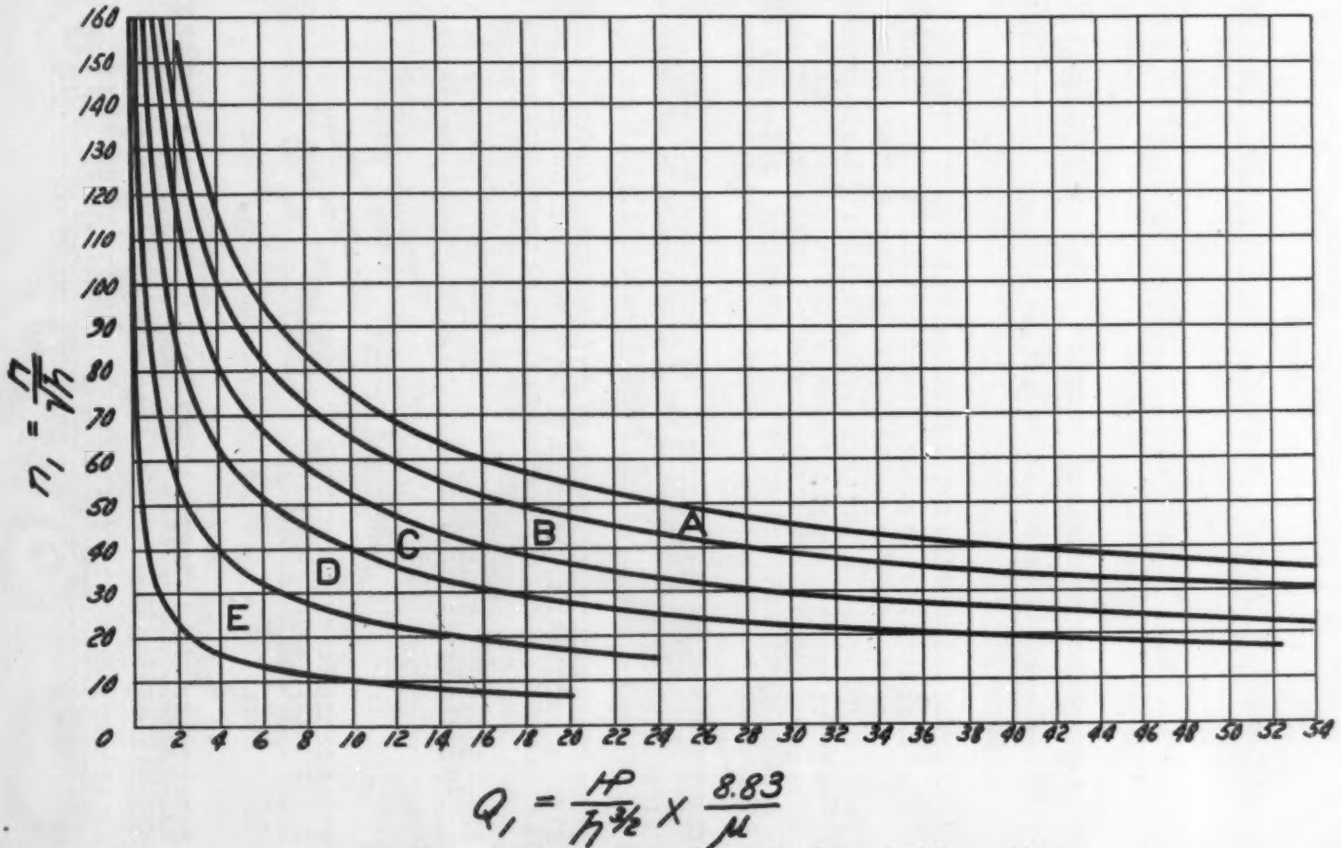


Fig. 26. Curve Showing Proper Runner for Given Conditions.

TABLE VI.

[Copyrighted by Geo. J. Henry. Jr.. Mechanical and Hydraulic Engineer. Rialto Building. San Francisco]

Head or Pressure in feet	Pressure in lbs. per sq. in.	Spouting velocity in ft. per sec.	H. P. from 1 cu. ft. per sec. @ 80 % eff.	H. P. from 1 in. Ø jet @ 80% eff.	Rev. X Diam in inches running at 100% spouting vel.	Square Root of head in feet	Three halves power of head in feet	Five Fourths power of head in feet	Head in feet	Equivalent head in meter
h	p	$V_{sp}=8.025\sqrt{h}$	.09076h	.00396$h^{\frac{3}{2}}$	$1838\sqrt{h}$	$\sqrt{h}$	$h^{\frac{3}{2}}$	$h\sqrt[4]{h}=h^{\frac{5}{4}}$	h	h_m
1	.434	8.025	.0908	.0040	1838	1.000	1.	1.000	1	.3048
5	2.17	17.93	.4538	.0443	4110	2.236	11.18	7.474	5	1.52
10	4.34	25.38	.9076	.1252	5812	3.162	31.62	17.782	10	3.05
15	6.51	31.08	1.3614	.2297	7118	3.873	58.10	29.515	15	4.57
20	8.68	35.89	1.8150	.3544	8220	4.472	89.44	42.290	20	6.10
25	10.85	40.12	2.2689	.4950	9190	5.000	125.00	55.890	25	7.62
30	13.02	43.95	2.7227	.6507	10054	5.477	164.31	70.210	30	9.14
35	15.19	47.48	3.1763	.8222	10874	5.916	207.06	85.130	35	10.67
40	17.36	50.76	3.6302	1.002	11625	6.325	253.00	100.600	40	12.19
45	18.53	53.83	4.0842	1.196	12330	6.708	301.90	116.550	45	13.72
50	21.70	56.75	4.5380	1.400	12996	7.071	353.50	132.970	50	15.24
60	26.04	62.16	5.4455	1.841	14237	7.746	464.80	166.970	60	18.29
70	30.38	67.14	6.3515	2.471	15377	8.366	624.00	201.800	70	21.34
80	34.72	71.46	7.2608	2.837	16440	8.944	715.50	239.300	80	24.39
90	39.06	76.13	8.1640	3.387	17435	9.486	854.30	277.200	90	27.44
100	43.43	80.25	9.0764	3.961	18380	10.00	1000.0	318.2	100	30.48
110	47.80	84.18	9.9820	4.570	19282	10.49	1154.0	359.5	110	33.53
120	52.15	87.88	10.880	5.204	20128	10.95	1314.0	370.6	120	36.57
130	53.45	91.49	11.798	5.869	20953	11.40	1482.0	438.5	130	39.62
140	60.70	94.94	12.706	6.358	21745	11.83	1656.0	481.5	140	42.67
150	65.00	98.23	13.613	7.271	22498	12.24	1836.0	524.1	150	45.72
160	69.35	101.52	14.520	8.008	23251	12.65	2024.0	569.0	160	48.77
170	73.70	104.65	15.428	8.780	23969	13.04	2217.0	614.0	170	51.82
180	78.00	107.70	16.335	9.566	24668	13.42	2415.5	659.2	180	54.86
190	82.40	110.58	17.243	10.370	25330	13.78	2618.3	705.2	190	57.91
200	86.65	113.47	18.150	11.200	25990	14.14	2828.0	752.0	200	60.96
210	91.00	116.28	19.059	12.052	26634	14.49	3043.0	799.6	210	64.01
220	95.35	119.00	19.967	12.923	27260	14.83	3263.0	847.1	220	67.06
230	99.65	121.74	20.874	13.805	27883	15.17	3485.5	895.7	230	70.10
240	104.2	124.40	21.781	14.726	28472	15.49	3718.0	944.3	240	73.16
250	108.6	126.87	22.689	15.665	29060	15.81	3955.0	993.8	250	76.20
260	112.9	129.45	23.597	16.601	29630	16.12	4191.5	1043.8	260	79.25
270	117.2	131,85	24.503	17.570	30200	16.43	4436.0	1094.0	270	82.30
280	121.6	134.26	25.411	18.551	30751	16.73	4684.0	1145.0	280	85.35
290	126.0	136.67	26.318	19.562	31302	17.03	4938.5	1198.0	290	88.39
300	130.3	138.99	27.277	20.580	31836	17.32	5196.	1248.5	300	91.44
310	134.6	141.32	28.135	21.625	32369	17.61	5460.	1301.0	310	94.49
320	139.0	143.57	29.041	22.798	32882	17.89	5756.	1354.0	320	97.54
330	143.3	145.80	29.950	23.747	33398	18.17	5996.	1407.0	330	100.58
340	147.6	147.98	30.856	24.833	33894	18.44	6270.	1460.0	340	103.64
350	152.0	150.15	31.764	25.938	34390	18.71	6549.	1514.0	350	106.70
360	156.4	152.23	32.671	27.050	34868	18.97	6830.	1568.0	360	109.74
370	160.7	154.40	33.579	28.192	35364	19.24	7118.	1623.0	370	112.80
380	165.0	156.45	34.486	29.305	35823	19.49	7399.	1670.8	380	115.83
390	169.4	158.50	35.394	30.503	36302	19.75	7702.	1732.2	390	118.88
400	173.7	160.50	36.301	31.68	36760	20.00	8000.	1788.7	400	121.93
410	178.1	162.50	37.210	32.88	37220	20.25	8302.	1844.9	410	124.98
420	182.5	164.43	38.120	34.31	37660	20.49	8662.	1900.0	420	128.03
430	186.7	166.44	39.024	35.32	38140	20.74	8918.	1953.0	430	131.08
440	191.0	168.37	39.932	36.39	38562	20.98	9187.	2015.0	440	134.13
450	195.5	170.21	40.840	37.81	38984	21.21	9545.	2094.7	450	137.18
460	199.7	172.13	41.746	39.08	39425	21.45	9866.	2130.0	460	140.23
470	204.0	174.00	42.656	40.36	39849	21.68	10190.	2188.2	470	143.28
480	208.4	175.82	43.562	41.63	40271	21.91	10520.	2247.0	480	146.33
490	212.7	177.78	44.470	42.97	40605	22.14	10850.	2305.4	490	149.37
500	217.1	179.44	45.380	44.28	41100	22.36	11180.	2364.5	500	152.42
510	221.5	181.20	46.285	45.58	41500	22.58	11515.	2423.5	510	155.47
520	225.9	182.98	47.190	46.95	41905	22.80	11855.	2482.0	520	158.52
530	230.1	184.73	48.101	48.32	42310	23.02	12200.	2543.0	530	161.57
540	234.5	186.50	49.008	49.70	42715	23.24	12550.	2603.0	540	164.61
550	238.9	188.80	49.915	51.09	43100	23.45	12898.	2663.0	550	167.66
560	243.1	189.88	50.823	52.48	43489	23.66	13250.	2724.0	560	170.71
570	247.6	191.57	51.730	53.88	43873	23.87	13607.	2785.0	570	173.75
580	252.0	193.24	52.636	55.31	44260	24.08	13965.	2846.0	580	176.80
590	256.3	194.92	53.545	56.73	44645	24.29	14331.	2908.0	590	179.85
600	260.6	196.53	54.455	58.19	45014	24.49	14698.	2969.5	600	182.90
610	265.0	198.22	55.360	59.66	45400	24.70	15067.	3033.0	610	185.95
620	269.3	199.82	56.270	61.14	45768	24.90	15438.	3094.0	620	189.00
630	273.7	201.42	57.178	62.62	46135	25.10	15812.	3156.2	630	192.04
640	278.0	203.03	58.082	64.12	46500	25.30	16191.	3219.0	640	195.09
650	282.3	204.65	58.990	65.64	46870	25.50	16573.	3282.1	650	198.14
660	286.6	206.17	59.898	67.14	47218	25.69	16955.	3345.0	660	201.19
670	291.0	207.85	60.803	68.71	47568	25.88	17349.	3408.0	670	204.24
680	295.3	209.30	61.712	70.24	47935	26.08	17734.	3472.7	680	207.29
690	299.7	210.81	62.620	71.78	48285	26.27	18126.	3536.8	690	210.33
700	304.0	212.26	63.530	73.32	48615	26.45	18514.	3600.0	700	213.38
710	308.4	213.87	64.400	74.94	48984	26.65	18923.	3665.0	710	216.43
720	312.8	215.30	65.340	76.51	49313	26.83	19318.	3729.2	720	219.48
730	317.1	216.83	66.250	78.12	49662	27.02	19723.	3794.5	730	222.52
740	321.2	218.28	67.160	79.72	49993	27.20	20130.	3902.0	740	225.57
750	325.7	219.80	68.070	81.27	50342	27.39	20542.	3925.5	750	228.62
760	330.0	221.25	68.975	82.98	50675	27.57	20953.	3992.0	760	231.67
770	334.4	222.70	69.880	84.62	51004	27.75	21368.	4057.0	770	234.72
780	338.8	224.13	70.798	86.28	51336	27.93	21786.	4122.5	780	237.77
790	343.1	225.58	71.700	87.92	51633	28.11	22208.	4188.0	790	240.82
800	347.5	226.95	72.602	89.60	51979	28.28	22623.	4255.0	800	243.87
810	351.9	228.40	73.510	91.11	52308	28.46	23051.	4322.0	810	246.91
820	356.2	229.84	74.415	91.28	52640	28.64	23484.	4388.0	820	249.96
830	360.6	231.20	75.325	94.69	52952	28.81	23911.	4450.0	830	253.01
840	364.9	232.57	76.239	96.40	53264	28.98	24342.	4522.0	840	256.06
850	369.2	233.92	77.145	96.93	53578	29.15	24775.	4589.5	850	259.11
860	373.6	235.38	78.050	99.89	53908	29.33	25223.	4658.0	860	262.15
870	378.0	236.73	78.958	101.62	54220	29.50	25664.	4725.0	870	265.20
880	382.3	238.00	79.865	103.37	54517	29.66	26101.	4793.0	880	268.25
890	386.6	239.40	80.775	105.14	54829	29.83	26549.	4862.0	890	271.30
900	391.0	240.75	81.680	106.93	55140	30.00	27000.	4929.5	900	274.35
910	395.2	242.02	82.588	108.75	55435	30.16	27445.	5002.5	910	277.40
920	399.5	243.40	83.495	110.52	55745	30.33	27905.	5067.0	920	280.44
930	403.9	244.68	84.402	112.31	56035	30.49	28357.	5136.0	930	283.49
940	408.2	245.98	85.312	114.11	56328	30.65	28812.	5204.0	940	286.54

TABLE VI.

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Head or Pressure in feet	Pressure in lbs. per sq. in.	Spouting velocity in ft. per sec.	H. P. from 1 cu. ft. per sec. @ 80 % eff.	H. P. from 1 in. O jet @ 80% eff.	Rev. X Diam. in inches running at 100% spouting vel.	Square Root of head in feet	Three Halves power of head in feet	Five Fourths power of head in feet	Head in feet	Equivalent head in meter
h	p	$V_{sp}=8.025\sqrt{h}$	.09076h	.00396$h^{\frac{3}{2}}$	$1838\sqrt{h}$	$\sqrt{h}$	$h^{\frac{3}{2}}$	$h\sqrt[4]{h}=h^{\frac{5}{4}}$	h	h_m
950	412.6	247.32	86.22	115.97	56660	30.82	29280.	5273.	950	289.6
960	416.9	248.61	87.13	117.80	56950	30.98	29742.	5343.	960	292.6
970	421.2	249.9	88.03	119.61	57250	31.14	30202.	5412.	970	295.7
980	426.6	251.18	88.94	121.49	57550	31.30	30675.	5483.	980	298.7
990	430.0	252.48	89.85	123.36	57840	31.46	31145.	5553.	990	301.8
1000	434.3	253.75	90.76	125.20	58140	31.62	31620.	5623.	1000	304.8
1020	444.0	256.32	92.58	129.03	58700	31.94	32579.	5764.	1020	310.9
1040	452.0	258.8	94.39	131.56	59275	32.25	33218.	5907.	1040	317.0
1060	460.0	261.38	96.20	136.80	59840	32.56	34512.	6048.	1060	323.1
1080	468.5	263.70	98.01	140.57	60400	32.86	35490.	6190.	1080	329.2
1100	478.0	266.20	99.82	144.52	60920	33.17	36489.	6335.	1100	335.3
1120	486.5	268.60	101.64	148.49	61510	33.47	37489.	6478.	1120	341.4
1140	495.0	270.91	103.46	152.29	62060	33.76	38450.	6622.	1140	347.5
1160	503.5	273.31	105.28	156.49	62600	34.06	39510.	6770.	1160	353.6
1180	512.0	275.65	107.20	160.55	63140	34.35	40539.	6915.	1180	359.7
1200	521.0	277.99	108.90	164.65	63670	34.64	41571.	7062.	1200	365.8
1220	529.5	280.31	110.72	168.78	64200	34.93	42617.	7210.	1220	371.9
1240	538.0	282.56	112.55	172.92	64730	35.21	43663.	7358.	1240	378.0
1260	547.0	285.20	114.36	177.35	65240	35.54	44782.	7510.	1260	384.0
1280	555.5	287.12	116.17	181.42	65757	35.78	45805.	7656.	1280	390.1
1300	564.5	289.39	117.99	185.68	66270	36.06	46880.	7806.	1300	396.2
1320	572.5	291.54	119.80	189.95	66780	36.33	47960.	7956.	1320	402.3
1340	581.5	293.80	121.61	194.31	67280	36.61	49060.	8108.	1340	408.4
1360	590.5	295.95	123.43	201.96	67780	36.88	50899.	8258.	1360	414.5
1380	599.0	298.11	125.25	203.07	68280	37.15	51270.	8410.	1380	420.6
1400	607.0	300.30	127.06	207.50	68780	37.42	52393.	8563.	1400	426.7
1420	616.0	302.39	128.88	212.04	69260	37.68	53540.	8715.	1420	432.8
1440	625.0	304.55	130.70	216.37	69743	37.95	54630.	8870.	1440	438.9
1460	634.0	306.63	132.50	220.96	70230	38.21	55789.	9022.	1460	445.0
1480	642.5	308.71	134.33	225.30	70710	38.47	56883.	9180.	1480	451.1
1500	651.0	310.80	136.15	229.92	71190	38.73	58045.	9334.	1500	457.2
1520	659.5	312.89	137.95	234.52	71660	38.99	59210.	9490.	1520	463.3
1540	668.0	314.90	139.77	239.34	72130	39.24	60433.	9631.	1540	469.4
1560	677.0	317.00	141.60	244.08	72600	39.50	61622.	9803.	1560	475.5
1580	686.0	319.00	143.40	248.77	73058	39.75	62803.	9960.	1580	481.6
1600	694.5	321.00	145.21	253.48	73520	40.00	64000.	10120.	1600	487.7
1620	703.0	323.00	147.03	258.25	73975	40.25	65203.	10275.	1620	493.8
1640	712.0	325.00	148.85	263.06	74435	40.50	66420.	10457.	1640	499.9
1660	720.5	326.92	150.66	267.84	74885	40.74	67630.	10595.	1660	506.0
1680	729.0	328.93	152.48	272.77	75340	40.99	68865.	10756.	1680	512.1
1700	737.0	330.85	154.30	277.61	75780	41.23	70090.	10917.	1700	518.2
1720	746.0	332.79	156.10	282.50	76220	41.47	71330.	11076.	1720	524.2
1740	755.0	334.72	157.92	287.45	76670	41.71	72575.	11237.	1740	530.3
1760	763.5	336.65	159.74	292.41	77103	41.95	73832.	11400.	1760	536.4
1780	772.0	338.58	161.55	297.45	77540	42.19	75100.	11560.	1780	542.5
1800	780.0	340.51	163.66	302.47	77975	42.43	76374.	11720.	1800	548.6
1820	789.0	342.35	165.18	307.50	78410	42.66	77640.	11886.	1820	554.7
1840	798.0	344.29	167.00	312.63	78840	42.90	78935.	12052.	1840	560.8
1860	806.5	346.13	168.81	317.43	79270	43.13	80145.	12215.	1860	567.0
1880	815.0	347.98	170.63	322.85	79700	43.36	81520.	12360.	1880	573.0
1900	824.0	349.93	172.45	328.00	80120	43.59	82820.	12543.	1900	579.1
1920	832.5	351.66	174.26	332.88	80540	43.82	84050	12710.	1920	585.2
1940	841.0	353.51	176.08	338.46	80960	44.05	85460.	12876.	1940	591.3
1960	850.0	355.29	177.89	343.65	81380	44.27	86770.	13040.	1960	597.4
1980	859.0	357.12	179.70	348.97	81780	44.50	88110.	13208.	1980	603.5
2000	866.5	358.89	181.52	354.22	82196	44.72	89440.	13374.	2000	609.6
2020	876.0	360.66	183.33	359.52	82603	44.94	90780.	13540.	2020	615.7
2040	885.5	362.50	185.15	364.91	83015	45.17	92140.	13709.	2040	621.8
2060	893.0	364.27	186.96	370.30	83420	45.39	93500.	13878.	2060	627.9
2080	902.5	366.02	188.78	375.70	83825	45.61	94860.	14047.	2080	634.0
2100	910.0	367.80	190.60	381.30	84230	45.83	96245.	14085.	2100	640.1
2120	919.0	369.49	192.41	386.55	84630	46.04	97605.	14385.	2120	646.2
2140	928.0	371.25	194.22	392.06	85030	46.26	98990.	14558.	2140	652.3
2160	936.5	373.00	196.04	397.60	85430	46.48	100380.	14728.	2160	658.4
2180	945.0	374.70	197.86	403.05	85820	46.69	101777.	14896.	2180	664.5
2200	953.5	376.40	199.68	408.65	86220	46.90	103180.	15066.	2200	670.6
2220	962.5	378.15	201.50	414.28	86610	47.12	104600.	15238.	2220	676.6
2240	971.0	379.85	203.30	419.80	86986	47.33	106020.	15420.	2240	682.8
2260	979.5	381.51	205.12	425.48	87375	47.54	107440.	15581.	2260	688.9
2280	988.5	383.00	206.94	431.10	87760	47.75	108860.	15754.	2280	695.0
2300	996.5	384.90	208.75	436.80	88150	47.96	110300.	15928.	2300	701.0
2320	1007.	386.58	210.56	442.50	88530	48.17	111740.	16100.	2320	707.2
2340	1016.	388.18	212.38	448.15	88910	48.37	113170.	16269.	2340	713.2
2360	1025.	389.87	214.20	454.00	89290	48.58	114640.	16450.	2360	719.4
2380	1033.	391.95	216.00	459.40	89670	48.79	116000.	16623.	2380	725.4
2400	1042.	393.15	217.82	465.60	90050	48.99	117575.	16775.	2400	731.5
2420	1051.	394.78	219.63	471.40	90420	49.19	119040.	16966.	2420	737.6
2440	1059.	396.45	221.46	477.35	90800	49.40	120540.	17150.	2440	743.7
2460	1068.	398.05	223.27	483.04	91160	49.60	122010.	17327.	2460	749.8
2480	1077.	399.68	225.10	489.07	91540	49.80	123500.	17501.	2480	755.9
2500	1086.	401.25	226.90	495.00	91895	50.00	125000.	17678.	2500	762.0
2520	1094.	402.85	228.71	500.95	92260	50.20	126500.	17852.	2520	768.1
2540	1103.	404.46	230.52	506.90	92630	50.40	128000.	18030.	2540	774.2
2560	1112.	406.07	232.34	513.00	92955	50.60	129530.	18218.	2560	780.2
2580	1120.	407.59	234.16	518.95	93380	50.79	131040.	18385.	2580	786.4
2600	1129.	409.20	235.97	524.95	93720	50.99	132540.	18564.	2600	792.5
2640	1146.	412.32	239.60	534.85	94460	51.38	135064.	18924.	2640	804.7
2680	1164.	415.45	243.23	549.50	95150	51.77	138750.	19285.	2680	816.9
2720	1181.	418.50	246.87	562.25	95860	52.15	141980.	19644.	2720	829.0
2760	1199	421.64	250.50	574.20	96560	52.54	145000.	20005.	2760	841.2
2800	1216.	424.68	254.12	586.80	97255	52.92	148175.	20370.	2800	853.4
2840	1233.	427.65	257.76	599.35	97400	53.29	151330.	20730.	2840	865.6
2880	1250.	430.70	261.39	612.10	98635	53.67	154570.	21100.	2880	877.8
2920	1268.	433.68	265.00	624.90	99320	54.04	157800.	21464.	2920	890.0
2960	1285.	436.63	268.64	637.95	100000	54.41	161080.	21836.	2960	902.2
3000	1303.	439.53	272.29	650.65	100667	54.77	164310.	22203.	3000	914.4
3200	1390.	447.00	290.43	717.28	103970	56.57	181200.	24070.	3200	975.3
3400	1476.	468.00	308.58	785.25	107170	58.31	198280.	25963.	3400	1036.4
3600	1563.	481.50	326.71	854.70	110280	60.00	216000.	27886.	3600	1097.4
3800	1650.	494.33	344.90	927.60	113300	61.64	234230.	29833.	3800	1158.3

Types of Francis Turbine Runners	A	B	C	D	E
Range Spec Speed	68 – 80	50 – 68	38 – 50	24 – 38	10 – 24
Range Rim Speed	79 – 82	73 – 79	68 – 73	64 – 68	60 – 64
Range n_1	32 – 155	26 – 160	20 – 160	15 – 160	15 – 160
Range Q_1	2 – 50+	1.25 – 45+	0.8 – 40+	0.5 – 38	0.3 – 22
Efficiency	Full Gate – 72% ¾ Gate – 75% ½ Gate – 68%	Full Gate – 77% ¾ Gate – 79% ½ Gate – 73%	Full Gate – 80% ¾ Gate – 82% ½ Gate – 76%	Full Gate – 81% ¾ Gate – 83% ½ Gate – 77%	Full Gate – 80% ¾ Gate – 82% ½ Gate – 76%

Fig. 27-31. Cross Sections and Water Passages of Various Runners.

The Application of Formulae.

Many of the formulae that have been heretofore given, involve the use of constants which may be readily tabulated for particular use; and to facilitate calculations a slide rule determination of the more important constants applicable to heads from 1 ft. to 3800 ft. and .33 meters to 1153.3 meters is given in table VI.

Fig. 32. Slow Speed Runner.

Column 1 and column 10 give the head in feet.

Column 2 the equivalent pressure in pounds per sq. in.

Column 3 the spouting velocity in feet per second.

Column 4 is useful in determining the horsepower available (at 80 per cent efficiency) from any given number of cubic feet per second for any given head

$$\text{H.P.}_{80} = Q \times \text{Const.} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (28)$$

and the Quantity in cubic feet per second necessary for the production of a required horsepower (assuming 80 per cent efficiency).

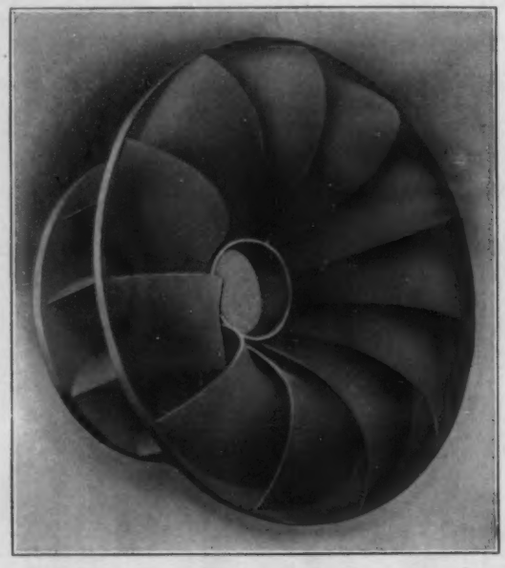

Fig. 33. High Speed Lower Head Runner.

$$\text{is } Q = \frac{\text{H.P.}_{80}}{\text{Const.}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (29)$$

Column 5 gives at once the horsepower from any size jet or the jet diameter for any requisite horsepower (assuming 80 per cent efficiency) by the formulae

$$\text{H.P.} = \text{Const.} \times \text{jet diameter}^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (30)$$

$$\text{jet diameter} = \sqrt{\frac{\text{H.P.}}{\text{Const.}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (31)$$

Column 6. The constants here given are the product of the revolutions and diameter of runners if running at 100 per cent of the spouting velocity therefore we should correct the constant found in this column by an appropriate valve from table IV and we may then write

$N \times D_p =$ Const. (from table IV) $\times$ per cent of spouting velocity at which the pitch circle is to run, placing these values

$= K_c$ and per cent V_{sp} respectively we may write

$$n = \frac{K_c \times \text{per cent } V_{sp}}{D_p} \quad \ldots\ldots\ldots\ldots\ldots\ldots (32)$$

$$D_p = \frac{K_c \times \text{per cent } V_{sp}}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (33)$$

Column 7 is particularly useful in determining speeds under unity head for comparisons under different heads, as we have seen that speeds vary as the square root of the heads and that

$$n_1 = \frac{n}{\sqrt{h}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (34)$$

and we may write $$\frac{n_u}{n_m} = \frac{\sqrt{h_u}}{\sqrt{h_m}} \quad \ldots\ldots\ldots\ldots\ldots (35)$$

where n_u and n_m are the speeds of the same wheel under heads of h_u and h_m respectively.

Column 8 is useful in making comparisons of energy outputs under different heads or unity head, for (by formula 26).

$$\text{H.P.}_1 = \frac{\text{H.P.}}{h^{5/2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (26)$$

and we also write by proportion

$$\frac{\text{H.P.}_u}{\text{H.P.}_m} = \frac{h_u^{5/2}}{h_m^{5/2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (36)$$

Column 9 is for determination of specific speeds.

$$S = \frac{n\sqrt{\text{H.P.}}}{h^{5/4}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (25)$$

Column 11 gives the head in meters equivalent to the heads in feet in columns 1 and 10.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

October 21.

A decision was rendered providing for a reduction in the wholesale rate on electric power sold by the Snow Mountain Water and Power Company to the Napa Valley Electric Company. The order puts into effect a reduction from an average of 1.81 cents per kilowatt hour to a rate varying from 1 cent to 1.25 cents per kilowatt hour, and the Commission states that it expects the Napa Valley Electric Company to reflect this decrease in lower rates to its consumers.

An order was issued calling upon the electric railroads of the State to furnish necessary inventories and statements to enable the Commission to proceed with the appraisement of their properties.

October 22.

Decision was rendered in the case of the City of Pasadena versus the Southern California Edison Company, in which the former had complained that the latter had reduced its rate in Pasadena to a point which made impossible the profitable operation of the municipal lighting plant of Pasadena. The City of Pasadena charged discrimination and asked that the Southern California Edison Company be compelled to raise its rate in Pasadena. In its decision the Commission sustains the objection raised by the Southern California Edison Company, that the City of Pasadena itself has the power to fix rates within its limits, and such power does not rest with the Railroad Commission. The Commission suggests that the issue may be presented by a complaint from the unincorporated territory charging discrimination.

October 25.

A decision was rendered granting authority to the Sutter Butte Canal Company to issue $52,000 in bonds for refunding purposes, and to issue $197,000 of promissory notes in exchange for outstanding certificates of indebtedness.

A decision was rendered granting permission to the San Jose Terminal Railway Company to issue $400,000 of bonds, to be used for the construction of an electric railway between San Jose and Alviso, and for the establishment of a boat service between Alviso and San Francisco.

The Commission is preparing a uniform system of accounts and classifications for gas companies and for electric companies, which will be printed as soon as possible and distributed to interested parties.

October 29.

A decision was rendered granting permission to the Coast Valleys Gas & Electric Company to take over the property of the King City Water, Light & Power Company.

L. W. Warmoth applied to the Commission for permission to sell his telephone line extending from Corning in Tehama County, to Newville, in Glenn County, to the Pacific Telephone & Telegraph Company.

October 31.

The Commission rendered a decision granting permission to R. H. Gaud to transfer a street railway franchise in Santa Barbara to the Santa Barbara & Suburban Railway Company and has authorized the Santa Barbara and Suburban to exercise the franchise rights thereby granted. The decision requires that the stock of the company be not transferred. The Commission states that the franchise should have provided for a more liberal application of reduced fares for school children.

An order was issued granting permission to the Coast Counties Gas & Electric Company to purchase the Davenport Light & Power Company, of Santa Cruz County.

JAPANESE IMPERIAL GAS ASSOCIATION.

The rapid increase in the number of gas companies in Japan has led to the formation of an Imperial Gas Association, with headquarters at Tokyo, T. Takamatsu being president. There are about 60 member companies and about 40 more companies in the process of formation. The association has taken over the Gas Journal, "Gas Kai," and will publish it under their own auspices.

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POWER AND GAS

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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The Financial Outlook

The past week, typical of human life, was ushered in with hope and promise in the bosoms of three national figures. Then came the great voice of the people in utterance of thoughtful expression. The vote is cast; the result is heralded with joy throughout the nation—joy to the victor's friends for in it they see a popular expression, unmistakable in its endorsement of the attributes they themselves see in their leader; joy to the friends of the vanquished, for in it they see the cessation of months of strenuous, earnest work and inwardly feel that self-satisfaction incident upon a battle well-fought.

Through all the turbulent months, the old ship of state has rolled on serene in its majesty. Never before has a presidential election been so little reflected in the industry and activity of the nation. Indicative of this supreme indifference to the political situation, the recently compiled data of the bureau of railway economics presents interesting figures.

For instance data on file with the Interstate Commerce Commission show that the net earnings for August of this year—the latest month available for complete information—shows larger footing than for any preceding August—so large in fact that the month of October, 1909, is the only month on record excelling in this excellent tabulation.

From every quarter come reports that the manufacturer of electrical supplies is overburdened with early deliveries. Such a state of affairs augurs well for the concentrated effort now being planned by all affiliated electrical organizations to place the standard of accomplishment even still higher in 1913. So strenuous and so successful have been these past campaigns however, the onlookers may truly say—as did the Kansas farmer, speculating as to whether the Lord was with him, when he was safely deported by the whirlwind into the next county: "Well, if he ware, he certainly ware a-goin some."

To the unexcelled workers for the aggrandizement of electrical appliances, strength to your strong right arm!

The Element of Risk

In any reasonable determination of what is justice in a controversy between both parties to an issue, it must be admitted that the view points of both parties should be carefully investigated. This, for instance, is the sole basis upon which equitable rates may be established for the public utility company. Such a method of procedure leads inevitably to the conclusion that the rates charged by a utility company must not be greater than the service is worth to the customer, and must not be less than sufficient to yield a fair or reasonable return to such public utility company.

The complete control of a public utility by a just and legally constituted regulating commission is undoubtedly the solution of a former perplexing problem. Under

this new regime sinking funds are established to take care of depreciation and obsolescence. In addition to the accumulation of such funds a reasonable return is then allowed for the invested capital. Since the public does not guarantee this return, however, there is unquestionably a risk—at times, indeed a risk of such proportions that the utility may become swamped or bankrupt. It is said that depreciation and obsolescence funds should care for all possible contingencies. Yet we challenge the man to come forth and say accurately what the next twenty years—yes even the next ten years may bring forth. Each day are brought to light new inventions. Let a single brilliant thought be attuned to apply solar radiation under carefully planned energy storage to human needs of cooking and heating the home. What a tremendous curtailing of power consumption would instantly arise. Seven thousand horsepower per acre eternally dissipated in sunny climes is indeed a fruitful field for inventive thought.

But in the computation of engineering risks we can only foretell the future by what has happened in the past, and hence the present depreciation and obsolescence funds. The investor, however, is curtailed by the commission in putting a limit to his return, thus dooming him to ruin in case of an unforseen cheaper supply of energy being made possible by invention. In theory the mode of procedure is correct, yet in view of events which have happened in the past, something more should be provided for the investor than commending his case in the event of a new invention, to a wise and far-seeing providence. This statement may be ahead of its time but we state that in the highest evolution of regulation in which the return on invested money is kept at a minimum, the investor should be guaranteed against such an unforseen event, for it is a possible contingency which may arise. Indeed if such an unforseen event should materialize, the people at large could well afford to compensate the former faithful servant in view of the tremendous gain realized from the innovation.

Scientific Organization of Power Companies

Two factors seem paramount in bringing about efficiency in economic evolution of the modern central station—the one relates to the general scheme of organization management and the other to the scientific development of the commercial side of the power output. It is evident that the highest development of the first mentioned factor would practically produce the power product at a minimum cost, while the latter factor, in its highest development, would dispose of this product under the most advantageous commercial return to the company.

Let us for the moment consider one phase of the organization management now in force among Western hydroelectric companies. Two conflicting methods are found in the control of that department generally entitled "Light and Power" or its equivalent. One method calls for a single head whose duty it is to superintend all construction, maintenance and operation. Such a person, solely responsible to the president of the corporation, has the direction of the engineering force in new construction as well as the keeping intact of the work already completed, including the actual operation of the various plants. On the other hand, in many other companies the custom long tried and approved in the great railway organizations of the country is enforced—namely, the segregation of new construction from that of maintenance and operation of the plants. And, well may these functions be segregated, except in cases of extreme rareness. Seldom do we find in the human make-up the requisite traits combining both functions of management necessitated. A casual study into the characteristics of human beings brings to light that certain of us are born with ideas of constructive imagination, enthusiasm for creating new work under new and untried conditions, an enthusiasm which sweeps all before it. On the other hand, another group of equally powerful, action-creating minds exists, whose natural endowment makes them leaders among men, leaders in the use of men and economy in operation. In a word, the one group are experts in bringing to life new layouts, while the latter are experts in keeping alive, under the most economic methods, what the former group create. It would seem, then, unless the central station is fortunate in possessing the man who has this most unusual combination of mental equipment, that the most efficient scheme is brought about by dividing the duties falling under the light and power department or its equivalent, into two separate groups, each on a par and each reporting directly to the president.

Returning now to a discussion of the second topic in the opening paragraph, let us consider one phase of organization today, which is materially aiding many of the large central stations of the west to dispose of their product under the most advantageous commercial return to the company. The most forceful reflective thought which dawns upon the student of central station economics, as he delves into its various ramifications, is that by no means is the most profitable load the one which, as a rule, brings the highest gross return. So varying and many-sided is this subject that some of the larger companies have created a separate department of experts whose duty it is to consider as industrial engineers the most profitable methods of readjusting the present connected load. Even deeper study than this is made of the correct and uniform method of connecting up new consumers at prices satisfactory to the consumer and profitable to the central station. But the greatest good that arrives from the creation of such a department is that it imposes a special function upon the industrial engineer—that of looking afield and developing new applications for electrical energy. The cut-throat policy of taking from a competitor a load, which at best is but returning a meager profit, is suicidal. But on the other hand, the central station, presuming the policy of prying into new fields, suggesting to new groups of industries new and enlarged uses of electrical energy, is indeed the modern industrial general who, like Alexander the great, will triumph over all obstacles and some day have that unique privilege of sighing because of a scarcity of more worlds to conquer.

PERSONALS.

Rudolph W. Van Norden, consulting engineer, spent the past week at Lake Spalding and Nevada City, Cal.

F K. Lane, secretary and general manager of the Seattle Light Company of Seattle, Washington, is at San Francisco.

F. S. Pratt, vice-president of the Stone & Webster Corporation, who has been at Seattle recently, has left for Boston.

W H. Shepard and **Allen G. Jones** have returned to the San Francisco offices of the General Electric Company from the East.

James S. Thompson, salesmanager of the McGraw-Hill Book Company, publishers of technical books, is a recent San Francisco visitor.

Sidney Sprout, consulting engineer, is inspecting the construction work of the California-Oregon Power Company's system in Northern California.

F. D. Nims, electrical engineer with the Western Canada Power Company, Ltd., of Vancouver, B. C., has been appointed Jovian Statesman for British Columbia.

John Coffee Hays, president, and **S. L. Stovall,** hydraulic engineer, with the Mt. Whitney Power Company of Visalia, California, were at San Francisco this week.

Benjamin C. Holst, district manager of the Northern Electric & Manufacturing Company, Ltd., of Vancouver, B. C., is making a two months' business trip throughout the East.

C. B. Nicholls, who has been representing the engineering department of H. M. Byllesby & Company in the Tacoma office has been transferred to the engineering department at Chicago.

Delos F. Wilcox has been at San Francisco during the past week as advisor to the Supervisors with regard to the proposed charter amendment relating to street railway franchises.

W. L. Goodwin, general manager of the Pacific States Electric Company, is at Seattle in connection with the establishment of a Seattle branch of the Pacific States Electric Company.

H. S. Wells, new business manager for the Pacific Power & Light Company, has returned to Portland, Oregon, after attending a meeting of the N. E. L. A. Committee on Electricity on the Farm, called by Chairman **S. V. Walton** at San Francisco.

Frederick H. Newell, director of the government reclamation works, has been making a tour of the western irrigation projects and closely investigating conditions. In Boise, Idaho, the evennig of October 24 he spoke to the engineers of the state upon the work the government is doing.

H. N. Lauritzen, Pacific Coast manager for the Nelite Works of the General Electric Company, has returned to San Francisco after a three weeks' trip throughout the Northwest and Denver. The San Francisco headquarters of the Nelite Works have been established at 86 Third street.

Herbert Gates has succeeded to H. W. Clapp's position with the electrical department of the Southern Pacific Company and **W. C. Myers** has been transferred from the West Alameda shops to succeed B. C. Edgar, Mr. Clapp and Mr. Edgar now being with the Columbus Railway and Light Company, as announced in these columns last week.

Samuel Kahn has been appointed assistant to Elmer Dover in the operation of the western properties of H. M. Byllesby & Company. This group includes the Oregon Power Company, Northern Idaho & Montana Power Company, the Tacoma Gas Company, the Everett Gas Company and the Western States Gas & Electric Company. Mr. Kahn was formerly connected with the operating department at Chicago.

A. W. Leonard has been appointed general manager for the Puget Sound district of the Stone & Webster Corporation, succeeding the late R. T. Laffin; **H. T. Edgar,** manager of the Seattle division, has been promoted to the office of district manager in the Central Western States, with headquarters in Boston; and **A. L. Kempster,** superintendent of railways, has been promoted to the office of manager of the Seattle division with the title of general superintendent, in succession to Mr. Edgar

C. O. Mailloux, vice-president on international arrangements for the International Electrical Congress at San Francisco in 1915, is at San Francisco from New York City to consult with the exposition authorities and with **Henry A. Lardner,** vice-president on Pacific Coast relations. Shortly after his return to New York Mr. Mailloux will start for Europe with the authority of President Chas. C. Moore to extend invitations to foreign scientific and technical societies to attend the Congress.

OBITUARY.

The passing of Eugene R. Hallett, manager of Louis Sloss & Company of San Francisco, on Sunday evening, October 26, came as a severe shock not alone to his many personal friends but to all those handling western hydroelectric securities. In addition to his many regular managerial duties with his firm, Mr. Hallett published during the past year a book entitled "Public Utilities Act of California." This book gained a well-merited highly favorable comment from all quarters Mr. Hallett was a young man of high ideals, possessing an unusually keen business perception.

MEETING NOTICES.

Electrical Development League.

The Electrical Development League will meet at Tait's Cafe, San Francisco, at 12:15, Tuesday, November 30. W. A. Clowen, vice-president of the Pacific Surety Company, will talk on "Various Phases of the Roseberry Liability Insurance Law and Its Effect on the Employers of Labor."

Portland Section, A. I. E. E.

The next regular meeting of the Portland Section of the A. I. E. E. will be held in the Assembly Hall of the Electric Building at 8:00 p. m., sharp, November 19, 1912. A paper will be presented by W. D. Scott, engineer of the Pacific Telephone Company, on the subject of "Leased Wire Service on the Pacific Coast."

Los Angeles Section, A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers held its regular monthly meeting at Hotel Hollenbeck, on Tuesday evening, October 29, 1912, 65 members and visitors being present. President George A. Damon was in the chair. Professor Sorenson, chairman of the programme committee, announced that the subject for the November meeting would be "Illumination," by Professor Harris J. Ryan of Stanford University, California. Mr. Damon then introduced Mr. J. E. Macdonald, who read a paper entitled "Legislation vs. Regulation in Electrical Distribution." This paper was illustrated by lantern slides and was thoroughly discussed by the following: E. R. Northmore, R. E. Cunningham, Berry, E. F. Scattergood, R. H. Manahan, H. B. Lynch, E. Y. Porter, F. B. Lewis, Harris, T. A. Panter.

TRADE NOTES.

Among recent orders received by the Westinghouse Electric and Manufacturing Company are reported the following: The British Columbia Electric Railway Company, Vancouver, B. C., for five 50-ton locomotives to be equipped with four No. 208B-3 motors and HB. control.

The California Oregon Power Company have made a contract with the Shasta Valley Irrigation Company to supply power for an irrigation pumping system to be installed near Montague, Cal. This will comprise a 6500 gallon pump raising about 112 feet and a 1250 gallon pump raising about 86 feet. The pumps will be Worthington, double-suction volute type. The constant speed motors have not yet been selected.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

SPECIFICATIONS FOR THE INSTALLATION OF MOVING PICTURE MACHINES AT PORTLAND, OREGON.

Compiled by F. D. Weber.

It is not only suggested, but strongly urged, that, wherever possible, the moving picture machine be located, not, as is usually the custom, at the entrance to the room, but at the end opposite to the entrance. Then in case of a fire which is not confined within the enclosure, the audience will not have to pass near the flames in leaving the theater.

Work and Appliances. All wiring, apparatus, etc., not specifically covered by special rules herein given must conform to the Standard Rules and Requirements of the National Electrical Code.

1. **Arc Lamp** used as part of moving picture machines and dissolvers, etc., must be constructed similar to arc lamps of theatres, so far as practicable as specified by the National Electrical Code, and the wiring of same must not be of less capacity than No. 6 B & S. gage copper wire.

2. **Wiring** must all be in approved rigid or flexible conduit (this includes booth, auditorium, dressing rooms or any part of moving picture theatre). See Rule 38, N. E. C. Ed. 1911. Each picture machine, dissolvers, flood or spot light must be wired as a 2-wire circuit, and a 2-pole switch and cut-out must cut off and protect the resistance and arc for every machine. All conduit must be brought to a point as near as possible to the arcs of the machines. Connections from arcs to conduit must be made with asbestos covered wire. Conduit must be rigidly supported in every case.

3. **Rheostats or Other Necessary Current Reducing Devices** must be made entirely of non-combustible material and of approved design. Must be mounted on non-combustible support in such a manner that there will be an air space of at least 3" on all sides. The rheostat must be of enclosed design or be completely enclosed by a netting with a mesh not greater than ½". When the resistance is not hung in operating room and the same is excessively hot, the same must be properly protected by asbestos. We strongly advise that resistances be suspended from the ceiling on strain insulators. When it is possible the resistance should be located outside booth.

4. **Top and Bottom Reels** must be enclosed in steel boxes or magazines, each with an opening of approved construction at bottom or top so arranged as not to permit entrance of flame to magazine. No solder is to be used in the construction of these magazines. The front side of each magazine must consist of a door spring hinged and swinging horizontally, and be provided with a substantial latch.

5. **Automatic Shutter** must be provided and must be so constructed as to shield the film from the beam of light whenever the film is not running at operating speed. Shutter must be permanently attached to the gate frame. In addition, a non-automatic shutter must be provided, placed in front of condenser so as to be readily closed by hand.

6. **Extra Films** must be kept in individual metal boxes equipped with tight-fitting covers.

7. **Machine Operation.** Must be operated by hand. (Motor-driven will not be permitted, except when moving picture machines of approved type are used.) If driven by a motor, moving picture machines must be of a type expressly designed and approved for such operation, and when so approved, motor-driven machines, when in charge of a skilled operator, may be permitted by the Inspection Department of this Bureau.

This permission must be given in writing by the Inspection Department.

8. **Reels Containing Films Under Examination or in Process of Rewinding** must be enclosed in magazines or approved metal boxes similar to those required for films in operation, and not more than 2 feet of film shall be exposed in booth.

9. **Picture Machines** must be placed in an **Enclosure or House** constructed in the following manner:

10. **Construction of Enclosure or House** (Booth).

(a) **Size of Booth.** All booths to be at least 6 feet 6 inches high, or high enough to provide space for gravity sliding doors, with floor space to vary according to the number of machines in booths, as follows:

One picture machine, 6x6 feet.

One picture machine and one stereopticon, 9x6 feet.

Two picture machines and one stereopticon 12x6 feet.

For every additional machine, 3 feet in width must be furnished.

(b) **Openings** per machine in the booth, one for the operator and one for the machine. Opening for machine shall not be more than 8 inches high and 12 inches long. Operator's window shall be not more than 8 inches wide and more than 12 inches high. All openings in other portions of booth, except ventilator in ceiling and entrance doors, must not exceed 8 inches wide and 12 inches high. All openings to this booth, excepting entrance doors to this enclosure or house, must be arranged so as to be entirely closed by doors or shutters constructed in the following manner: Doors must be hung so that gravity will tend to close them (only vertical sliding doors will be approved) and be held open by a twine arranged in such a way that it will pass directly over the film when in place. All doors over openings, except entrance doors, must be sliding doors, and be constructed of two pieces of No. 22 U. S. Standard gauge (.0313 inches) galvanized iron, one piece placed on each side of ¼-inch asbestos; lap 1 inch around the corners, and the whole riveted together. The doors to lap over all edges of openings at least 1½ inches. The same to run in galvanized iron guides of at least No. 16 U. S. Standard gauge (.0625 inches), the guides to lap over door at least 1 inch, and fit snugly against the openings covered. The guides to be placed inside of the booth and all the heads of nails or screws holding same in place to be concealed by a single lock formed on the guides. These guides to be continued across bottom of opening to form a seat for the door to drop into. Corners of guides to be lapped and riveted. Guides to be made with square corners and doors to be made with square edges so doors will not bind when operated. The sides of all openings must be lined to outside and lap at least 2 inches over the outside of booth.

(c) **Ventilation** must be obtained through the ceilings in all booths to the outside air, and no ventilator to be of smaller size than 36 square inches in cross section per machine. This ventilator to be constructed with lock joints or rivets, and solder not to be depended upon for holding sheets of metal in place. The gauge of metal to be the same as used in the construction of iron booths.

(d) **Entrance Doors** must close against an angle iron rabbit $1x1x^{3}/_{16}$ inches, extending completely around openings, and be held closed by a metal rope and weight, the weight to run inside of protecting pipe, and the rope to pass over a pulley. This door when constructed of metal, must be constructed in a thoroughly substantial manner of equally as good fire resisting material as the booth itself and be braced so that same will not warp or get out of shape. When the door is constructed of wood and metal it must be constructed and hung according to the requirements of an approved

fire door. The size of the door shall not be larger than 2x6 feet.

(e) **Stationary Wooden Metal Lined Booth** to be constructed of sheating (ship-lap) at least ¾ inch thick, supported by 2x4-inch wooden studding, not more than 18-inch centers, presenting a smooth and solid surface on the inner side of booth. All studding, braces, etc., to be on the outside of booth. The ceiling and walls of booth must be lined with at least ⅛-inch asbestos under galvanized sheet iron as thick as No. 26 U. S. Standard gauge (.0188 inches), and the joints must be locked. The floor must be covered with galvanized sheet iron at least as thick as No. 22 U. S. Standard gauge (.0313 inches) sheet iron over a ⅛-inch asbestos . Metal must be thoroughly secured in position by nails and the heads covered by approved lock joint (see Figure I), made with the metal lining of the booth. Entrance door openings must not be larger than 2x6 feet. All other openings must conform to section (b).

Note—Outside the city limits of Portland, Oregon, the ⅛-inch asbestos in section (e) may be omitted.

[To be continued.]

PROGRAM FOR ANNUAL CONVENTION OREGON ELECTRICAL CONTRACTORS' ASSOCIATION, PORTLAND, DEC. 10, 11, 1912.

Tuesday, December 10.—10:00 a. m., Convention called to order at Moose Hall, Seventh and Morrison streets. Address of Welcome; response by Mr. J. H. Ralston, President Oregon Electrical Contractors' Association. Papers: The Relation of the Oregon Electrical Contractor to the Underwriters' Inspection Work in Oregon, Mr. F. D. Weber, Inspector Underwriters' Equitable Rating Bureau. The Relation of the Electrical Jobber to the Electrical Contractor, Mr. F. N. Averill, Manager Fobes Supply Company. What the National Electrical Contractors' Association is doing for the Electrical Contractor, Mr. Geo. H. Duffield, Special Representative of the N. E. C. A. Some Practical Statements from a Central Station Expert, Mr. O. B. Coldwell, General Superintendent Power and Light Department Portland Railway, Light & Power Company. Credit—Its Utility in the Modern Commercial World, Mr. L. B. Smith, Manager Credit Department Fleischner Mayer Company. Costs and Efficiency, Mr. P. L. Procter, Manager Pacific Audit Company.

Wednesday, December 11th—Trip to Portland Railway, Light & Power Company's power plant at Cazadero. Electric train leaves corner of First and Alder at 9 a. m. sharp. Be sure to be on time and not miss this very interesting trip. Luncheon at Estacada Hotel. Return to Portland; on arrival association members will meet at the Convention Hall in the Electric Building, Seventh and Alder streets, and proceed to the election of officers for the ensuing year, and to transact any other association business. 8 p. m., banquet and entertainment at the Multnomah Hotel.

The present officers of the association are: President, Jos. H. Ralston, Albany, Oregon; Vice-President, W. O. Fouch, Portland, Oregon; Secretary, S. E. Kilkenny, St. Johns, Oregon; Treasurer, John R. Tomlinson, Portland, Oregon.

WAREHOUSE INSTALLATION AT PORTLAND.

An interesting lighting and power installation has just been completed in Portland in the new warehouse for the Honeyman Hardware Company, on Ninth and Hoyt streets. This splendid building, which is entirely of re-enforced concrete construction, covers 100 x 100 feet of ground space, and is seven stories in height with basement, and is used exclusively for warehouse purposes by the above-mentioned hardware firm.

The wiring installation is, of course, installed throughout in galvanized conduit, the total number of circuits being 185, or approximately 24 circuits per floor. The panel boards on each floor are fed separately from a switchboard located in the basement, which gives the engineer and the night watchman perfect control of all lighting and power in the building. In addition to the control mentioned, the entire lighting and power service is controlled by an 800 ampere T. P. remote control circuit breaker. This breaker is in turn controlled by tripping switches located at the two main entrances of the building, thus giving firemen control of all current in the building (except elevator power and fire escape lights) in case of fire, as required by city ordinance.

The lighting of the entire building is made complete by the installation of approximately 500 Benjamin reflector sockets of 16-inch diameter, equipped with 40-watt Mazda lamps on all floors except the first, where they are equipped with 60-watt lamps, on account of a higher ceiling and a greater demand for illumination.

Each outlet in this building is also equipped with a Bryant 2309 ceiling pull switch, making a most efficient installation in so far that each outlet may be controlled separately. This has already been found one of the best investments in the building, as, by the old methods, it was found that the employees were in the habit of leaving an entire circuit burning, whereas with this new arrangement, only one lamp can be left burning at the most. The mounting for these switches was accomplished by concealing double outlets in the concrete ceiling about 18 inches apart, using one for the fixture outlet and the other for the switch, which was mounted on closed covers with stove bolts. The building was designed by Architect D. C. Lewis, and the electrical layout was designed and installed by the West Coast Engineering Company, R. G. Littler manager, 708 Couch Building, Portland, Oregon.

NEW CATALOGUES.

A 120 page catalogue on Multi-Stage turbines is being distributed by the De Laval Steam Turbine Company of Trenton, N. J. It includes much information of value to steam users.

Bulletin No. 137 from the Electric Storage Battery Company of Philadelphia, entitled "Some Recent Developments in the Lead Battery for Electric Vehicles" describes a number of recent improvements in the "Ironclad Exide" battery.

Bulletin No. 45 from Byron Jackson Iron Works of San Francisco is devoted to Jackson 1912 direct connected centrifugal pumps. In addition to an illustrated description of the various types of pumps the bulletin includes tables on the friction of water in pipes, duty of water for irrigation and direction for installing and starting centrifugal pumps.

The Kellogg Switchboard & Supply Company are distributing a number of unique circulars and post cards, which bear considerable human interest. These include a handsome four-color reproduction of a pen etching by Valleby, entitled "Neighborhood News," with the Kellogg telephone as the center of attraction. Another card gives a neat rendition of "Humpty Dumpty" to prove the strength of the Kellogg telephone. "Railway Telephone Cards" is the subject of an attractive six-page folder demonstrating their long life and water-proof qualities. "A Long Distance Call" is the title of the fourth of this interesting series.

ELECTRICITY ON THE FARM.

Stanley V. Walton, western chairman of the National Electric Light Association Committee on Electricity on the Farm, called a meeting of the committee at San Francisco last week and made preliminary arrangements to issue a handbook on the subject which will be published by the Commercial Section of the Association. The next meeting of the committee will be held at Portland in December. Future meetings will be held at Denver and Los Angeles.

THE PROGRESSIVE SPIRIT.[1]

BY S. M. KENNEDY.

In these latter days, the word "Progressive" is dinned into our ears to such an extent that some people are liable to misunderstand its meaning, or else get absolutely tired of it. However, we of the electrical fraternity know that as progress leads to perfection the progressive spirit is something which should be cultivated by all connected with our most important industry.

Let us glance at the results of the progressive spirit on businesses which we might consider co-related to the one in which we are engaged. I refer particularly to transportation, the telegraph and the telephone. Transportation has, properly speaking, three divisions: land, water and air. Land transportation may be traced to the period when mothers first strapped their babies on their backs. Since that time, more patents have been issued upon inventions relating to transportation than upon any other line of human activity. They range all the way from a little device for unhitching a runaway horse, to the latest idea in guiding an automobile. Think what this wonderful development has meant for the civilized world; how it has linked country with country and brought nation close to nation, so that together they might move forward to fulfill their destinies.

Before we pass the subject of transportation, I want to say that the progressive spirit has commanded that the horse must soon go. Already he is considered slow, and that means the beginning of the end. The swift moving gasoline car began to drive the horse to the wall, but even the gasoline smell alone would not kill or displace him. No, it is the development of the silent, odorless, convenient and flexible electric vehicle that has commenced pushing the horse back to the farm. Watch the electric wagon progress from this time on. Watch the streets of our city become clean, quiet and orderly. Watch the electric move the passengers and freight about the streets of Los Angeles. In five years from now, even the vegetable Chinaman will run an auto, and your children's children will have to go to a menagerie to see specimens of the once loved horse.

I am a believer in the future of the electric vehicle. Each month it asserts itself a little stronger. Not for touring long distances, but for city and suburban traffic, for quick express delivery and for heavy freight, for the active runabout and the family brougham.

As a spectator, I have been immensely interested in reading of the progress of telegraphy. When I was a boy I heard that among the early experiments was one which required twenty-six wires from one point to another, and at each end of each wire was a pig, and each pig represented a letter in the alphabet. The current sent over a wire made a pig squeal, and the receiver of the message knew that squeal called out the letter of the squealing pig. If that method were still in vogue, imagine what a smell would hover around great cities, and how the price of bacon would be climbing out of sight.

But by and by the progressive spirit worked out the code system, and a message could be sent one way at a time on a metallic circuit. Then some man stumbled onto the fact that if the ends of the wires were stuck into the ground, one would do just as well as two. Then new inventions were added to new inventions, and instead of one message one way on one line at one time, we have a multiplicity of messages each way on the same wire. That was progress in itself—enough for a century, but not enough for us. Marconi and others said, "why all this waste of wires?" "Why all these forests of poles?" and lo! wireless telegraphy was born. Each of us has his own opinion as to the marvels of the time we live in, but, gentlemen, my wonderment is the wireless message. To the uninitiated, it may seem reasonable that we can transmit a sound or a flash over a wire, but to send and receive real messages through unlimited, boundless space, makes a staggering impression upon my very ordinary intellect.

Away back at the time when the telegraph and the Atlantic cable were the most wonderful things in the world, a young man was desperately busy in a noisy machine shop in Boston. He was wholly absorbed in what appeared to be an absurd looking toy. For three years he had been toiling over it, and then on a hot June day in 1875, an almost inaudible sound—a faint twang—came from the machine itself. That twang of a spring was the first tiny cry of the new born telephone, as feeble and helpless as any other baby, and "with no language but a cry." That young man was Alexander Graham Bell, and that baby of his has grown until it is one of the greatest necessities of modern life. When it was patented, there was no name for it in the world's language, and its description called it "an improvement in telegraphy." It is a pretty young child today who would not know that it is nothing of the kind. It is as different from the telegraph as the eloquence of the orator is from the language of a deaf-mute.

The progressive spirit is working: the wireless telegram is with us now; it has become a fact. The wireless telephone is coming, and possibly it will soon be a factor in our everyday life. May be we may yet see the time when every man will be his own "Central," and with a pocket 'phone, he may be able to talk to whom he pleases, at his own sweet will.

In front of the beautiful Union Railway Station in Washington, D. C., there is this inscription:

> ELECTRICITY, carrier of Light and Power
> Devourer of Time and Space;
> Bearer of human speech over land and sea,
> Greatest servant of man—itself unknown.

We are told on good authority that there is invested in the electrical business in the United States over $6,000,000,000 and that this large investment has been piled up during the last thirty years. Thirty years ago electric lighting was a marvel; today it is in nearly every home. Every day sees some new application of electricity, which adds to our personal comfort, or the easier and more economic transaction of business.

The progressive spirit is perhaps more marked in lighting than in many of the every day necessities we think are ours by right. Our original human ancestor, as far as history can tell us, was the cave man. As his name indicates, this gentleman lived in a cave—mostly because he did not know what else to do about a home. His activity was much along the same lines as other animals. He arose with the sun, and retired at sunset. He had no desire to sit up late, and was "afraid to go home in the dark." The fact is he had no artificial light at all. He lived on roots and berries, and the raw flesh of some animals. He did not have to hunt for a cook, because he had no fire and no food that needed any preparation. His life was not without its compensations after all. Then one day he accidentally struck a piece of flint, and a spark arrived. From that spark our business started. The cave man was soon staying out at night, and his wife awaited his return with a pine torch to illuminate his cave and some meat stewing in a bronze kettle over a fire. Then bye and bye, grease commenced hanging around that kettle, which would drip into the fire, and somehow the successors of the cave man got the grease hitched onto a rope and the tallow dip was born of a capacity equal to one candle power. It took years to progress, but eventually we got the oil lamp—then artificial gas, and by that time they thought all that was good in lighting had been discovered. The world sat back contented with its illumination until about thirty years ago—and then in a crude form electric lighting was made commercially possible. There have

[1]Address to Electrical League of Southern California, Los Angeles, October 8, 1912.

been issued by the authorities at Washington over 58,000 patents on electrical subjects. We know a large percentage of these must be on lighting matters. It would seem as if the progressive spirit kept at it all the time. The department of commerce and labor is the authority for the statement that the United States uses more electrical energy than any three countries in the world, and is the most brilliantly lighted nation on the face of the earth. Between the Atlantic and the Pacific, and the Gulf and the Great Lakes, there are in use more than fifty million incandescent lamps, and over 800,000 arc lamps. If those fifty odd million of lamps were brought together in one spot, their resplendence would probably equal one of the lesser orbs of the solar system.

Those of us assembled here are engaged in this great electrical business, and speaking for myself, I am glad that during a portion of my career at least I have been given the opportunity to become a part of, and do a little to help along the greatest business in the world. We look back over marvelous discoveries, inventions and applications of electricity during the past 25-years, and we are liable to fold our hands and wear a smile of contentment. The man for whom my company is named, the man who has himself taken out 700 patents on electrical subjects, Thomas A. Edison, has something to mention about that.

To use his words: "we have just started on our electrical way." He considers the chances of big, new, electrical inventions "are much greater than before the telegraph, the telephone, the electric light and the electric motor were invented." He predicts that by 1925 fully fifty billion dollars will be invested in the electrical business, and fully five times as many people will be employed as at present, "most of them in branches for which we have not now even a name." Continuing, he adds "about 100,000,000 carbon filament lamps are made here every year, much the same in all essentials as a quarter of a century ago. We must break new ground. The electrical heating and cooking apparatus are now very ingenious, and better than any other means, but ten years hence they will be superseded and lodged in the museums with bows and arrows and muzzle loader guns."

Perhaps some of you men present get discouraged at times, and think that as so much has been done, there remains so little to accomplish. Well, then, just think again what I have quoted as the works of the electrical wizard, as to what he expects is yet to come.

If I were an electrical engineer, I would be worried all the time because the progressive spirit seems to be crawling along so slowly in the matter of efficiency in generation. Think of it When one of these lights in this room is turned on, the little carbon filament gives barely two per cent of the latent power of the oil burned, or the water force used in the distant power house. Ninety-eight per cent is wasted, dissipated and lost between the oil tank, or intake, and the incandescent lamp. Were every bit of the energy in the oil, or in the head of water, used when you turned on the switch, fifty lamps would have sprung into light instead of one. It is true we now look at the tungsten lamps as a great step forward. So they are, but consider how little of the energy is represented in the oil or water, is given back in the tungstens. One inventor recently speaks of the incandescent and arc lamps as "simply refinements of the torch of the primeval savage, or the common candle, and primitive and inefficient in their present highly developed form." If such is the case, there is plenty of opportunity for the development of the progressive spirit. When we get all that should be gotten of the latent power, we will have wondrous improvements in, and use for light. In all directions we hear the cry "give us more light." Already the carbon filament lamp is beginning to take a rapid movement in the direction of the graveyard, and the a.c. arc is being measured for its coffin. "Give us more light" is the cry in all parts of the land. Give us the protection which light brings, for before light robbers, cut-throats, incendiaries and assassins must fly. Soon all our country roads will be lined with electric lamps, and as for the cities, they will be as bright at night as the highways on a June evening in the land of the midnight sun. So, Mr. Engineer, you must progress to keep up with the demand, and you must hustle to keep a little ahead of it.

We are not all engineers, however, so let us take a look at the work that is laid out for the others. We who sell the product handled have still a task which needs careful study and constant effort to bring to a satisfactory basis, for others who may succeed us to build upon. We have had drummed into us, daily and hourly, from the moment we entered the business, a lot of talk and stuff about the "peak." Metaphorically speaking, we are wont to stand with our heads back and our faces turned upward, gazing at the marvelous height of the daily or annual peak, and we wonder where it will end. We think it may go out of sight, and that possibly it will get as high as some of the giant trees in the Yosemite Valley, which take two men and a boy to see the top. Gentlemen, I now wish to relieve your anxiety on this subject. This peak bugaboo is coming into its inheritance, and the progressive spirit is already giving it some early payments, square in the back of the neck. That peak business has lorded it over us until at times we were afraid of taking on an extra five kilowatts. Some of us remember a play called the Black Crook. In it there was a scene where the devil made a rapid exit through the floor of the stage. One night in San Francisco, when the play was in full swing, the devil started downward on the trap door but stuck half way. A man in the balcony was much impressed and called out, "Hurrah, Hell's full." One of these days we will take off our hats and shout, "Hurrah, the Peak is dead and the valley's full."

A central station plant ought to be fully loaded 24 hours daily. It does not have to sleep. It is this sleeping that has let that "peak" rule us. There are two elements that will not mix, any more than fire and water, namely load factor and peak. As the load factor goes up the peak diminishes, and I contend that in due course, by the aid of the progressive spirit, a 90 per cent load factor will be a reality.

But we have a lot to do before the load curve becomes a straight line—before the electrical consumption of the community in which we dwell has reached the saturation point. Many records are still to be broken and many reputations to be made if the progressive spirit is encouraged. There are many uses for electricity now, which are not nearly developed. There are many uses coming about which we may only dream of today. The workshops and the factories are eagerly reaching out for the money saving power. How about the farms and the country districts? The stores and office buildings are asking what else we can give them. How about the homes? I know that some of you will say, "Why, look what we have done in that direction?" Well, I'm looking, and what do I see. Electric lighting everywhere, but not enough, and not used for long enough hours. One or two appliances in the average home, just to show how useful they can be. But look at all the drudgery in the home which still may be relieved. Look at the tired women and weary men, who are wearing themselves out because they do not know where to turn for assistance. And all the time we have the servant to do their work, but they don't know it. It is our mission to teach them—to point the way to rest, ease and comfort, and incidetally raise our consumption and bury the peak forever.

NEWS NOTES

INCORPORATIONS.

SEATTLE, WASH.—Western Dry Battery Company, Inc., for $20,000; trustees, James Bennett, Harry E. Bennett and Roy V. Bennett.

PORTLAND, ORE.—Chas. R. McCormick, E. H. Meyers and E. F. McCormick & Company have filed articles of incorporation of the St. Helens Light & Power Company. The company is capitalized at $50,000.

PORTLAND, ORE—Bernard Frohnmayer W. F. Prier and T. J. Geisher and incorparators of the Frohnmayer Water Meter Company,, with a capital stock of $50,000. It is stated that the company will pay special attention to the manufacture and sale of contrivances having to do with the measurement of water.

ILLUMINATION.

BURNS, ORE.—A. Welch of Portland has taken over the electric light plant and has been granted a 25-year franchise.

BREMERTON, WASH.—The council has decided to establish a municipal lighting system and either buy the local plant or put in a competitive system.

LOS ANGELES, CAL.—November 16 has been fixed as the date for the election to determine whether a special lighting district shall be established at El Segundo.

MONTESANO, WASH.—The Northwest Electric & Water Works has made application for permission to build an electric light line from this city to Satsop along the public highway.

SEATTLE, WASH.—The city of Seattle may take over the street lighting contracts for Georgetown as soon as the contracts held by the Puget Sound Traction, Light & Power Company expire.

TACOMA, WASH.—An ordinance was passed authorizing the commissioner of light and water to purchase and install certain electric motors and transformers and appropriating $1700 to pay therefor from the light fund.

LOS ANGELES, CAL.—Plans to light 16¼ miles with ornamental cluster lights, in Van Nuys Lankershim lands in San Fernando Valley are under consideration, $75,000 being appropriated for that purpose. The lighting system will extend from the east line of the boulevard to Encino avenue to Ventura road.

SEATTLE, WASH.—The utilities committee of the city council have recommended for passage an ordinance which will submit to the voters at the March election the question of issuing $425,000 in bonds, the money to be expended in installing an auxiliary plant at the south end of Lake Union to aid the city lighting department.

LONG BEACH, CAL.—The Southern California Edison Company has ordered the installation of a $1,000,000 unit to the plant on the west side of the Long Beach harbor. This unit will have 28,000 h.p. The first two units of the plant will have 36,000 h.p. when the second unit is completed, which will be about December 1. The first and second units will cost about $2,000,000.

LOS ANGELES, CAL.—The Board of Public Utilities and the city council are to be requested by the Pasadena council to fix a base rate of 4 cents a kw.-hr. for electricity to be charged by the Southern California Edison Company to consumers in Los Angeles. The company is permitted under the city's rates ordinance to charge a base rate of 6½ cents. The city council of Pasadena at its last meeting directed that letters be sent to the governing bodies of Los Angeles and all other incorporated cities in Southern California served by the Edison company asking that the several cities reduce rates to a par with those now being charged by the Edison company in Pasadena. The Edison company's rates in Pasadena are lower than anywhere else in Southern California. The only reason that they are so low is because the Edison company for several years has been fighting the municipal electric light plant. Pasadena officials declare the Edison company is charging lower rates than it is entitled to charge in Pasadena, but is making up its losses by charging higher rates than it ought to charge in Los Angeles and eighteen other cities.

TRANSMISSION.

CASHMERE, WASH.—The Northwestern Electric Company proposes to expend $10,000,000 in developing the power of the Klickitat river.

CONCRETE, WASH.—The Pacific Northwest Traction Company of Bellingham, has applied for a franchise to bring their high power wires through here.

LA GRANDE, ORE.—The Eastern Oregon Light & Power Company has purchased the local light plant and is building a transmission line into the town of Elgin.

BREMERTON, WASH.—The Olympic Power Company has awarded the contract to Joe Stangler & Company of this place for constructing a concrete power house on Pacific avenue.

VICTORIA, B. C.—The British Columbia Electric Railway Company will expend $1,500,000 in increasing its power plant at Jordan River. The capacity is 12,000 h.p. and this will be doubled.

KAMLOOPS, B. C.—The date of opening bids for the Barrier river hydroelectric power plant, intake dam and flume system has been extended from noon, November 14, to noon, November 21.

MONTESANO, WASH.—The Northwest Electric & Water Works Company has applied to the board of county commissioners for permission to build an electric light line from this city to Satsop. The matter has been taken under advisement.

SALMON ARM, B. C.—F. Buchanan has been awarded the contract for the installation of line and transmission equipment for the electric light system being installed here. A power house will be built on Front street E. on property recently purchased from Dr. Reinhard.

LOS ANGELES, CAL.—Surveys have been completed and some material delivered for the construction of power transmission lines which will carry energy from the Pacific Light & Power Company, Crane Valley, Cal., to Los Angeles. The lines to run 5 miles east of Bakersfield.

LINDEN, CAL.—The Oro Electric Company has secured a ten acre site on the Witherby place for a power plant and will construct the necessary buildings at once. The representatives of the electric company report that they have secured sufficient contracts already to insure the erection of the plant.

KAMLOOPS, B. C.—Tenders will be received by the city clerk up to November 14 for the construction of the intake dam and flume system of the proposed hydroelectric power plant on the Barriere river DuCane, Dutcher & Company, consulting engineers, suite 911-14 Rogers Building, Vancouver, have the matter in hand Tenders must be addressed to the city clerk, marked "Tender for Dam and Flume." Certified check for 5 per cent of bid required.

OROVILLE, CAL.—The recent rain meant much to the hydroelectric companies, for it increased the flow of mountain streams to a considerable extent, renewed the flow of springs, and deposited moisture in such quantities that the added flow will be maintained for some time. The increase

in the flow of the Feather River, for instance, enabled the Great Western Power Company to take 2000 kw. from its steam plants and add it to the output of the hydroelectric plant at Big Bend.

SAN DIEGO, CAL.—The common council has adopted an ordinance ordering that all wires, cables and other contrivances used for transmission of electricity for light, heat, power and telephones, or any other purpose, be placed underground in conduits 18 inches below the surface. Transformers will be placed in manholes or basement vaults with metal doors. All wires are to be laid subject to the approval of the inspector of gas and electricity. The ordinance does not apply to wires or poles for street railway.

SAN FRANCISCO, CAL.—That approximately $25,000 will be spent during the winter in the enlarging of the capacity of the Crane Valley reservoir, is the statement made by A. G. Wishon of the San Joaquin Light & Power Company. The walls of the present dam will be increased in height three-quarters of its length which, when filled with the winter flood waters, will increase the capacity of power house No. 1 in this district to four times its present capacity. Emory Wishon was in San Francisco last week in consultation with two engineers. The work will start on the dam in about two weeks and will continue on through the winter months. Nearly 8000 barrels of cement are at present stored in power house No. 1, and there will be little difficulty in securing further supplies in Crane Valley, as the new Big Creek Railroad steams within a few miles of the power house.

TRANSPORTATION.

ALBANY, ORE.—Work has been started on the survey for the new P., E. & E. electric line from Albany to Wells.

ALBANY, ORE.—The Corvallis & Eastern Railway will be electrified between Albany and Corvallis. Work is to be begun shortly.

SALEM, ORE.—An electric line will be built from the Lake Labish district to connect with the Oregon Electric line and the Southern Pacific Railway. Work is to be started in the spring.

SEATTLE, WASH.—Special plans for furnishing 15 semi-convertible electric cars of pre-payment type for the Seattle Municipal Railway were referred to A. L. Walters, superintendent of streets and sewers.

PORTLAND, ORE.—A narrow gauge electric street railway service may be operated on Seventh street, this city. Calvin Heilig and M. C. Dickinson, have applied for a franchise. The matter will be taken up at the next regular meeting of the council

PACIFIC GROVE, CAL.—Sealed bids will be received up to December 2, 1912, for the sale of the franchise, applied for by the Pacific Grove Railway Company, for a franchise to construct and operate a single or double track street railroad in the city of Pacific Grove for a period of 30 years.

LOS ANGELES, CAL.—The city attorney has been instructed to redraft the proposed ordinance granting the Pacific Electric Railway Company a 21-year franchise to carry freight in the industrial district, so that the company shall be granted, instead of a 21-year franchise, a revocable permit

LOS ANGELES, CAL.—The Board of Public Works has issued an order that the Los Angeles Railway Company relay with heavy rails, its line on Temple street from Spring to Belmont avenue, alleging that this street has been torn up three times in the past year to make repairs necessary on account of light rails used. The corporation will be given 150 days in which to complete the work.

RIVERSIDE, CAL.—The Southern Pacific Railroad expects to have electric trains running between Colton and Riverside by February 1, also intends to haul all Salt Lake passenger trains running on Southern Pacific tracks between San Bernardino and Riverside by electric motors. In order to get a franchise to run over the streets in San Bernardino the Southern Pacific had to agree to discontinue the use of steam engines.

VALLEJO, CAL.—Hard Bros., who have the contract for excavating for the Vallejo & Northern Railroad Company in this city, have returned to Vallejo, bringing with them their teams, preparatory to resuming work. With the question of rights of way definitely settled, the road intends pushing operations in Vallejo and Hard Bros. expect to put a large force of men to work at once. Much of the excavating west of Sacramento street has already been done and work will now be expedited east of that thoroughfare across the newly acquired rights of way.

OAKLAND, CAL.—From reports received of progress on the line of the Oakland & Antioch Railway, it is probable that electric cars will be running between Oakland and Antioch by May 1, 1913. Construction work on a subway to permit the Oakland & Antioch trains to pass under the tracks of the Southern Pacific and Santa Fe lines has been started at a point near Avon. A large force of men and teams are doing excavation work at present with the aid of the latest improved type of grading machines. Work is being rushed in order that the subway may be finished within six months, the time specified in the contract. Piledrivers are at work on ferry slips at Chipps Island. It is planned to ferry the cars across the river at this point until the bridge can be constructed.

TELEPHONE AND TELEGRAPH.

PULLMAN, WASH—The Inland Telephone & Telegraph Company has been granted a 50-year franchise in this city.

SLATER, WASH.—A new telephone company is being organized to construct a line between Burbank and Slater. Mr. Stewart is the promoter.

ALTURAS, CAL.—W. J. Bradley and C. S. Ramage have bought the Alturas Telephone Company, including the long distance line between Alturas and Lakeview.

PASADENA, CAL.—What is said to be the first merger of two telephone companies ever forced by a California municipality is effective here, the Pacific and the Home companies being united under the name of the Pasadena Home Telephone Company. After long litigation, which ended in the Supreme Court, the Pacific was forbidden to operate in Pasadena without a franchise. The city then forced the company to pay $32,000 in bank franchise taxes and followed that action by refusing to grant a franchise until the corporation effected a merger with the Home Company. The combination is under the control of the Pacific Telephone Company.

SAN FRANCISCO, CAL.—Final drafts of the proposed ordinance reducing telephone rates in San Francisco have been received by the Telephone Users' Association from the engineers in charge of this matter. Initiative petitions will be immediately prepared by the attorneys for the association, and the ordinance will be submitted for the approval of the people within a short time. If the ordinance is sustained, it will bring into effect the first substantial cut in telephone rates made in San Francisco for many years. The principal reductions will be among the business and professional telephones. The $5 a month phone is cut to $4, with excess switches at 4 cents, a reduction of 20 per cent. The $7.50 phone is cut to $6, and from thence up to the phone which now costs $19.57; the cuts from 20 to 25 per cent. On the private exchanges used by the larger business houses and hotels, little or no change will be made in the flat rate, but the present charge of 2½ cents per switch is cut to 1½ cents, which is the price now charged by the telephone company for switches in excess of 3000 a month. Residence telephones are cut in lesser degree.